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RFI WORK PLAN ASSEMBLY F SITE INVESTIGATION PLAN SOLID WASTE MANAGEMENT UNITS 20, 22, 63, 30 AND 39 MILLINGTON SUPPACT TN
4/4/1996
ENSAFE/ALLEN & HOSHALL

(18)

ASSEMBLY F — RFI WORK PLAN
NAVAL SUPPORT ACTIVITY MEMPHIS
MILLINGTON, TENNESSEE

SITE INVESTIGATION PLAN
SWMUs 20, 22 and 63, 30, and 39

CTO-106
Contract Number: N62467-89-D-0318

Prepared for:

Department of the Navy
Southern Division
Naval Facilities Engineering Command
North Charleston, South Carolina

Prepared by:

EnSafe/Allen & Hoshall
5720 Summer Trees Drive, Suite 8
Memphis, Tennessee 38134
(901) 383-9115

April 4, 1996

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LIST OF ACRONYMS

ACGIH	American Conference for Governmental Industrial Hygienists
ANSI	American National Standards Institute
BCT	Base Realignment and Closure Cleanup Team
bls	below land surface
BTEX	benzene, toluene, ethylbenzene, and total xylene
CGI	Combustible Gas Indicator
CHASP	Comprehensive Health and Safety Plan
CLEAN	Comprehensive Long-Term Environmental Action Navy
cm/sec	Centimeters per second
CRZ	Contaminant Reduction Zone
DQOs	Data Quality Objectives
DRO	Diesel-range organics
E/A&H	EnSafe/Allen & Hoshall
EIC	Engineer-in-Charge
EZ	Exclusion Zone
FSA	Full Scan Analysis
GC/MS	Gas chromatograph/mass spectrometer
GRO	Gasoline-range organics
HAZWOPER	Hazardous Waste Operations and Emergency Response
IDLH	Immediately Dangerous to Life and Health
LEL	Lower Explosive Limit
mg/m^3	Milligrams per cubic meter
MSDSs	Material Safety Data Sheets
NSA	Naval Support Activity
NIOSH	National Institute of Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated biphenyls
PEL	Permissible exposure limit
PID	Photoionization detector
PPE	Personal protective equipment
ppm	Parts Per Million

RCRA	Resource Conservation and Recovery Act
REL	Recommended exposure limit
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SCBA	Self-contained breathing apparatus
SIP	Site Investigation Plan
SPF	Sun protection factor
SSHSP	Site-Specific Health and Safety Plans
STEL	Short-term Exposure Limit
SVOCs	Semivolatile Organic Compounds
SWMU	Solid Waste Management Unit
SZ	Support Zone
TCLP	Toxicity Characteristic Leaching Procedure
TLV	Threshold Limit Values
TN	Tennessee
TPH	Total petroleum hydrocarbons
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
UWT	Underground Waste Tank
VOCs	Volatile Organic Compounds

ASSEMBLY F — RFI WORK PLAN
NAVAL SUPPORT ACTIVITY MEMPHIS
MILLINGTON, TENNESSEE

SITE INVESTIGATION PLAN
SWMU 20
1594 UNDERGROUND WASTE TANK

CTO-106
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1.0 INTRODUCTION

As part of the U.S. Navy's Comprehensive Long-Term Environmental Action Navy program, the following Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Site Investigation Plan (SIP) has been prepared for a confirmatory sampling investigation at Solid Waste Management Unit (SWMU) 20, which is underground waste tank (UWT) 1594 at Naval Support Activity (NSA) Memphis, Millington, Tennessee. The primary reference for this SIP is the *Comprehensive RFI Work Plan, Naval Air Station Memphis, Millington, Tennessee* (EnSafe/Allen & Hoshall, 1994).

2.0 ENVIRONMENTAL SETTING

SWMU 20 is approximately 200 feet west of Fifth Avenue and C Street on the NSA Memphis Southside, southeast of Building 1594 (Figure 1). SWMU 20 consists of UWT 1594, which reportedly received waste oil and waste hydraulic fluid generated by the Air Traffic Control School. The installation date of UWT 1594 is unknown; it was removed in May 1992. The information obtained on SWMU 20 during the 1990 RCRA Facility Assessment (RFA) is in Attachment 1 of this document.

2.1 Topography

SWMU 20 and the surrounding area are characterized by relatively level, low-relief topography. The immediate area is covered by asphalt and surrounding areas have grass cover. Surface drainage is toward the south and west to an east-west oriented drainage ditch (SWMU 38) which flows into Big Creek Drainage Canal. A topographic map showing land surface elevations is provided in Attachment 2 of this document.

2.2 Geologic and Hydrogeologic Information

The regional and local hydrogeology are described in Sections 2.11 and 2.12, respectively, of the *Comprehensive RFI Work Plan*. Site-specific geologic and hydrogeologic information has been collected from the following sources:

Figure 1 Vicinity Map

- Several test holes completed on the NSA Memphis Southside, including two stratigraphic borings completed by the U.S. Geological Survey (USGS).

- Subsurface information obtained while installing two background well clusters, designated BG-02 and BG-04, on NSA Memphis Southside.

The following sections describe the geologic and hydrogeologic information for the NSA Memphis Southside.

2.2.1 Stratigraphic Test Borings

Test Hole Sh:U-89, approximately 3,000 feet northwest of SWMU 20, was drilled and logged in 1983 to prepare for installing Southside production well PW-5 in 1985. The USGS completed two stratigraphic borings on the Southside, designated as Test Holes 7 and 8 (Figure 1), in 1995. Test Hole 7 is approximately 2,100 feet northeast of SWMU 20. Test Hole 8 is approximately 3,200 feet south of SWMU 20, at the southeast corner of the sewage lagoons (SWMU 9) near the Big Creek Drainage Canal. Table 1 describes the lithology encountered in each stratigraphic test hole. As shown in Table 1, lithology in the upper interval of the test borings differs from north to south and west to east. Instead of loess and fluvial deposits, alluvium is present in the stratigraphic test boring nearest to Big Creek Drainage Canal (Test Hole 8). In addition, when comparing Test Hole Sh:U-89 to Test Holes 7 and 8, the fluvial deposits are thinner and the Cockfield Formation is thicker on the eastern part of the Southside. A copy of the boring log for Sh:U-89 is included in Attachment 3 to this document.

The USGS collected soil samples from Test Holes 7 and 8 and submitted them for geotechnical analyses (J. Carmichael, USGS, written communication, 1995). Table 2 presents the hydraulic conductivity results for the soil samples.

Table 1
Test Borings on the NSA Memphis Southside

Stratigraphic Unit	Sh:U-89[a,b]	Test Hole 7 (Sh:V-79)	Test Hole 8 (Sh:V-80)
Alluvium	Not present	Not present	Clayey silt, 0-35 feet bls[c]; sand and gravel, 35-45 feet bls (45')[d]
Loess	Silt and clay deposits, 0-38 feet bls (38')	Silt and clayey silt, 0-34 feet bls (34')	Not present
Fluvial Deposits	Sand and gravel, 38-97 feet bls (59')	Sand, gravel, and silt, 34-47 feet bls (13')	Not present
Cockfield Formation	Sand, silt, clay, and lignite, 97-134 feet bls (37')	Sand, clay, and lignite, 47-173 feet bls (126')	Sand, silty sand, clay, and lignite, 45-153 feet bls (108')
Cook Mountain Formation	Hard clay and silt from 134-160 feet bls (26'); confining unit for the Memphis Aquifer	Hard slightly silty clay from 173 feet bls to termination depth of boring at 202 feet; confining unit for the Memphis Aquifer	Hard slightly silty clay from 153 feet bls to termination depth of boring at 182 feet bls; confining unit for the Memphis Aquifer

Notes:
[a] — Sh:U-89 = USGS well designations
[b] — Lithologic description for Sh:U-89 based on driller's log contained in Attachment 3. Lithologic descriptions for Test Holes 7 and 8 based on oral communication with USGS representatives; geophysical logs are forthcoming in USGS publications.
[c] — bls = below land surface
[d] — (38') indicates thickness of formation

Table 2
Hydraulic Conductivity Analyses: USGS Test Holes 7 and 8

Test Hole	Sample Depth (feet bls)[a]	Vertical Hydraulic Conductivity (cm/sec)[b]
TH-7	10 - 12	2.83×10^{-7}
TH-7	160 - 162	1.04×10^{-7}
TH-7	200 - 201.5	3.48×10^{-7}
TH-8	17 - 19.5	2.41×10^{-6}
TH-8	180 - 182.5	1.76×10^{-9}

Notes:
[a] — bls = below land surface
[b] — Hydraulic conductivity determined using the following method: triaxial, constant head, undisturbed method; data reported in centimeters per second (cm/sec). Results obtained through written communication with Mr. Jack Carmichael of USGS.

2.2.2 Background Well Clusters 2 and 4

Two background well clusters, designated BG-02 and BG-04, were installed on the Southside in January 1995, in conjunction with the RFIs at Assembly A SWMUs. Figure 1 shows the background well locations and Attachment 3 contains the boring logs. Table 3 describes the lithology encountered at each background well location.

Table 3
Background Wells on the NSA Memphis Southside

Stratigraphic Unit	BG-02	BG-04
Alluvium	Not present	Not present
Loess	Silt and clay deposits, 0-29 feet bls[a] (29')[b]	Silt and clayey silt, 0-38 feet bls (38')
Fluvial Deposits	Sand and gravel, 29-77 feet bls (48')	Sand, gravel, and silt, 38-71 feet bls (33')
Cockfield Formation	Sand, silt, and clay, 77 feet bls to termination depth of the boring at 87 feet bls	Sand and clay, 71 feet bls to termination depth of the boring at 76 feet bls

Notes:
[a] — bls = below land surface
[b] — (29') indicates thickness of formation

The lithology encountered at background well locations BG-02 and BG-04 was similar to that of stratigraphic test hole Sh:U-89 and Test Hole 7 described above; however, the fluvial deposits at BG-02 were thicker (38 feet) than at Test Hole 7 (13 feet).

No groundwater monitoring wells exist at SWMU 20. However, background monitoring well cluster BG-04 is approximately 2,200 feet northwest of SWMU 20. The cluster consists of three monitoring wells, one each screened in the loess, upper fluvial deposits, and lower fluvial deposits. Groundwater measurements taken on March 30, 1995, indicate static groundwater levels in the wells are approximately 5 feet below land surface (bls) in the loess deposits, and 10 to 11 feet bls in the upper and lower fluvial deposits. Based on the topography and the

information contained in the conceptual model of the NSA Memphis hydrogeology (Section 2.12 of the *Comprehensive RFI Work Plan*), groundwater is presumed to flow southwesterly in the fluvial deposits. Within the NSA Memphis Southside, groundwater in the loess/shallow alluvium most likely moves primarily downward to recharge the fluvial deposits/deeper alluvium. In the immediate vicinity of SWMU 20, some water in the loess may move laterally and discharge to the south to the SWMU 38 drainage ditch.

2.3 Climatological Data

Regional climatological data are provided in Section 2.8 of the *Comprehensive RFI Work Plan.*

3.0 SOURCE CHARACTERIZATION

The *Underground Storage Tank Closure Report, Tank No. 1594* (National Salvage, 1992), contains information concerning the removal of UWT 1594 at SWMU 20. When UWT 1594 was removed, the excavated soil was stockpiled. Afterward, soil samples were collected from the four corners of the open tank pit and from the stockpiled soil. The tank pit soil samples were analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) and total petroleum hydrocarbons-gasoline range organics (TPH-GRO) and TPH-diesel range organics (DRO), while the stockpiled soil was analyzed for BTEX; TPH-GRO and TPH-DRO; toxicity characteristic leaching procedure (TCLP) lead, benzene, and TPH; and flash point. Results for the four tank pit samples had TPH-DRO concentrations of 21.6 parts per million (ppm) in the northeast corner, 298 ppm in the southeast corner, 1,089 ppm in the southwest corner, and 3,072 ppm in the northwest corner. The results for the stockpiled soil indicated a TPH-DRO concentration of 20,288 ppm and a TCLP TPH-DRO of 1.89 ppm. All other analytical parameters from both the tank pit and stockpiled soil samples were below method detection limits. The flash point of the stockpiled soil was greater than 160°F. The stockpiled soil was transported to the Browning-Ferris Industries, Inc., landfill in Millington, Tennessee, an approved facility for disposal of TPH-contaminated soil.

Field sampling will be performed as outlined in Section 4.3 of this SIP to determine whether contaminants are present. If contamination is verified, the scope of the investigation may be expanded to meet RFI requirements. Reference materials will be used to determine the physical, chemical, and migration/dispersal characteristics of any contaminants identified as exceeding appropriate action levels. The procedures and references used to determine these characteristics will be documented in an RFI report.

4.0 CHARACTERIZATION OF HAZARDOUS CONSTITUENT RELEASES

4.1 Previous Investigations

The data from the *Underground Storage Tank Closure Report, Tank No. 1594,* indicate a release may have occurred prior to the UST removal. No other investigations or site inspections were available concerning SWMU 20.

4.2 Data Gaps

The following data gaps will be the focus of this investigation:

- The potential for surface soil contamination associated with UWT 1594.
- The potential for subsurface soil contamination associated with UWT 1594.
- The potential for groundwater contamination associated with UWT 1594.

Concentrations of contaminants identified in soil and groundwater at SWMU 20 will be compared to background soil and groundwater concentrations as determined from the five background monitoring wells installed across NSA Memphis in 1995 and from eight additional background monitoring wells installed in 1996 to determine whether measured values occur naturally or indicate contamination. Soil and groundwater samples collected from the original background monitoring wells were analyzed for full scan analysis (FSA) using the following methods:

- Volatile organic compounds (VOCs), U.S. Environmental Protection Agency (USEPA) Method 8240
- Semivolatile organic compounds (SVOCs), USEPA Method 8270
- TPH, USEPA Method 418.1
- TPH-GRO, Tennessee (TN) Modified 8015/GRO
- TPH-DRO, TN Modified 8015/DRO
- Chlorinated pesticides/polychlorinated biphenyls (PCBs), USEPA Method 8080
- Organophosphorus pesticides, USEPA Method 8140
- Chlorinated herbicides, USEPA Method 8150
- RCRA Part 264, Appendix IX Total Metals, USEPA Method 6010/7000 series
- Total cyanide, USEPA Method 9010

Surface soil and groundwater samples from the recently installed (1996) monitoring wells will be analyzed for Appendix IX metals.

4.3 Objective of Proposed Field Investigation

The objective of the proposed field investigation is to fill the data gaps identified in Section 4.2. All samples will be collected and processed in accordance with Section 4 of the *Comprehensive RFI Work Plan*. If contamination is identified at SWMU 20, the Base Realignment and Closure Cleanup Team (BCT) will review the sampling results to determine whether a second round of investigation, to include soil borings and/or monitoring wells, will be necessary.

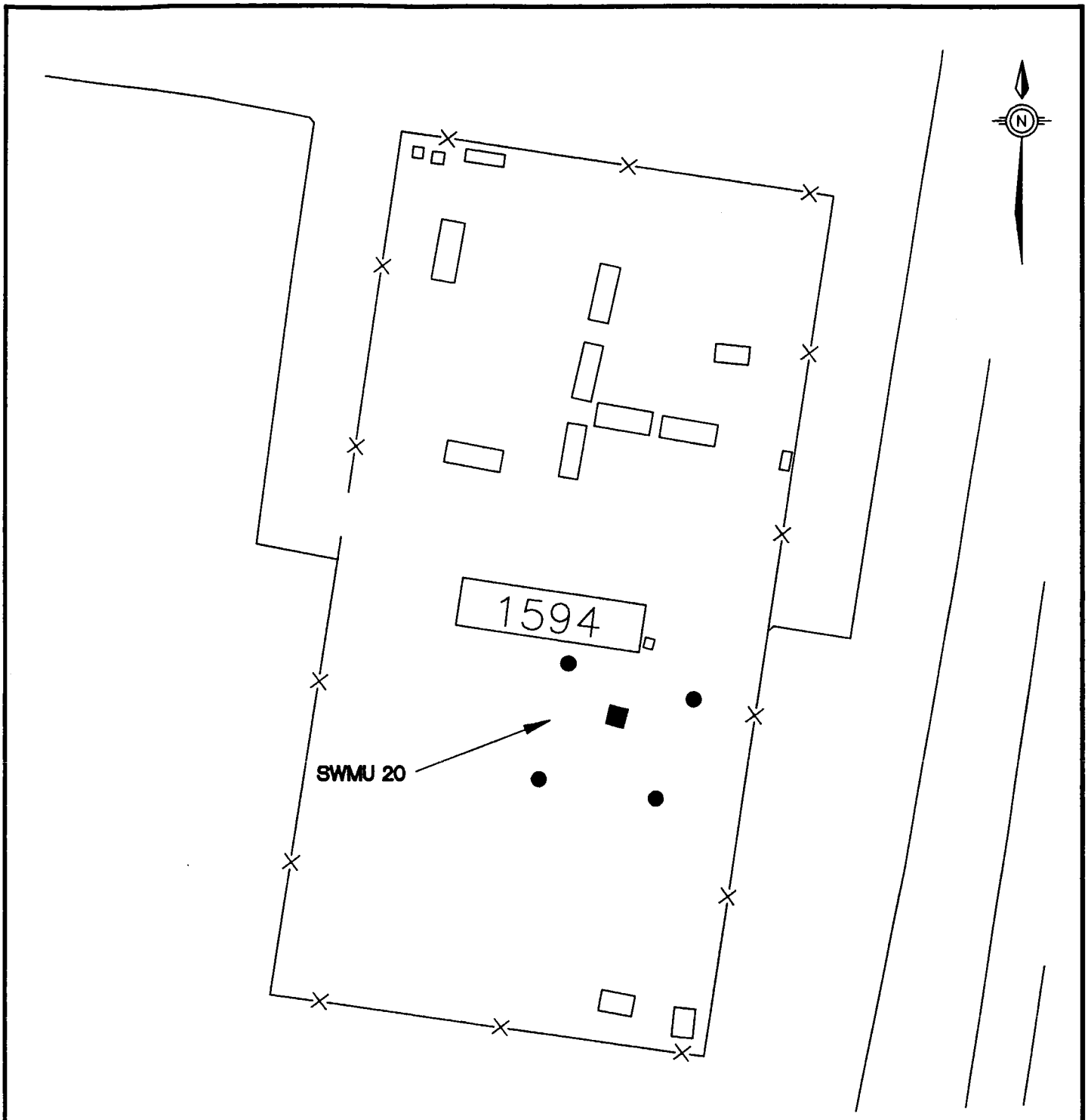
Field personnel may deviate from the strategy outlined below if field conditions or data (i.e., visual observations or field screening results) suggest additional or different intervals may be successfully sampled or yield more useful information. Any deviations will be documented in the field logbook and the SIP report. The investigatory area may then be expanded or concentrated, based on the results of the initial data.

4.3.1 Soil

The proposed soil investigation will consist of hand auger and Geoprobe sampling (as outlined in Section 4.4.4.3 of the *Comprehensive RFI Work Plan*) for field and/or laboratory analysis. Four sampling locations have been selected as shown in Figure 2. Sample locations were selected outside each corner of the former tank pit excavation. Soil samples will be collected from the surface to 1 foot deep (upper interval) using a hand auger and at a depth equivalent to the bottom of the tank pit using the Geoprobe (lower interval). The upper interval samples will be sent to an offsite laboratory for FSA using methods outlined in Section 4.2. The lower interval samples will be analyzed in the field with a gas chromatograph/mass spectrometer (GC/MS) for VOCs (USEPA Method 8240). At least 25% of the soil samples analyzed onsite will be split for confirmatory VOC analysis (USEPA Method 8240) by an offsite laboratory.

4.3.2 Groundwater

The proposed groundwater investigation will consist of Geoprobe sampling (as outlined in Section 4.4.4.3 of the *Comprehensive RFI Work Plan*) for field and/or laboratory analysis. Based on previous work conducted at other SWMUs, the Geoprobe is anticipated to be able to penetrate through the loess and into the fluvial deposits to a refusal depth greater than 50 feet bls. Groundwater samples will be collected from all four of the Geoprobe locations around UWT 1594, as dictated by field conditions (i.e., buried utilities could cause some sampling locations to be moved). Groundwater samples will be obtained from the first water-bearing zone in the loess and from the fluvial deposits, if possible. The groundwater samples will be analyzed in the field with a GC/MS for VOCs (USEPA Method 8240). At least 25% of the groundwater samples analyzed onsite will be split for confirmatory VOC analysis (USEPA Method 8240) by an offsite laboratory.



LEGEND

● SAMPLING POINTS

50 0 50

SCALE FEET

RFI WORK PLAN
NSA MEMPHIS
MILLINGTON, TENNESSEE

FIGURE 2
SWMU 20—SAMPLING POINTS

DWG DATE: 03/29/96 | DWG NAME: 94SP20

4.3.3 Soil Boring/Monitoring Well Phase

After the BCT reviews the analytical data from the first phase of the investigation, a second phase, consisting of installing and sampling soil borings and monitoring wells, may be implemented. The number, locations, and depths of soil borings and/or monitoring wells will be determined using data from the first phase of this investigation. An addendum to this plan describing the proposed drilling, sampling, and analytical strategies for an expanded investigation will be prepared and submitted to the BCT for review and comment, should a second phase be required.

4.3.4 Analytical Requirements

Soil and groundwater samples analyzed in the field with a portable GC/MS will adhere to Level II-equivalent Data Quality Objectives (DQOs). Samples submitted to an offsite laboratory will adhere to Level III-equivalent DQOs for 95% of the samples and Level IV-equivalent DQOs for the remaining 5%. Field personnel will determine which samples will receive Level IV DQOs. Table 4 shows the tentative number of samples to be collected and the analyses to be performed.

Table 4
Proposed Sampling and Analytical Requirements — SWMU 20

Method	Sample Matrix/Type	Number of Samples	Analysis
Hand Auger	Soil — upper interval	4	FSA[a]
Geoprobe	Soil — lower interval	4	VOC[b]
Geoprobe	Groundwater	4 (loess) 4 (fluvial deposits)	VOC[b] VOC[b]

Notes:

[a] — FSA (Full Scan Analysis) to include VOC, SVOC, TPH (418.1), TPH-GRO, TPH-DRO, chlorinated pesticides/PCBs, organophosphorus pesticides; chlorinated herbicides, total metals (Appendix IX), and cyanide.

[b] — VOC analysis to be performed in the field with a GC/MS. At least 25% of the total number of samples will be split and submitted to an offsite laboratory for confirmatory VOC analysis.

4.4 Sample Management

Sample management procedures will adhere to Sections 4.12 and 5 of the *Comprehensive RFI Work Plan.*

4.5 Sample Custody

Sample custody procedures will adhere to Section 4.12.5 of the *Comprehensive RFI Work Plan.*

4.6 Quality Assurance/Quality Control

Quality assurance/quality control procedures to be followed during this investigation will adhere to Section 4.14 of the *Comprehensive RFI Work Plan.*

4.7 Decontamination Procedures

Decontamination procedures will adhere to Section 4.11 of the *Comprehensive RFI Work Plan.*

4.8 Investigation-Derived Waste

Investigation-derived waste will be handled as specified in Section 4.13 of the *Comprehensive RFI Work Plan.*

5.0 POTENTIAL RECEPTORS

SWMU 20 is approximately 3,000 feet southeast of the nearest offsite residence and 75 feet south of the nearest NSA Memphis office personnel at Building 1594. The storm water from SWMU 20 discharges into SWMU 38, which in turn discharges into the Big Creek Drainage Canal approximately 1,400 feet south of SWMU 20. Big Creek Drainage Canal may serve as a food and water source for various animals. SWMU 38 comprises drainage ways in populated areas of NSA Memphis; therefore, the potential exists for infrequent contact with surface water and sediment in these ditches by NSA Memphis personnel. Offsite, the potential exists for contact with surface water and sediment by the general public due to unrestricted access to

Big Creek Drainage Canal. According to NSA Memphis personnel, no fishing or swimming occurs in Big Creek Drainage Canal, but children may play near it.

Other potential receptors include two production wells shown in Figure 1, PW-4 and PW-5. SWMU 20 is approximately 4,400 feet southeast of PW-4 and approximately 3,000 feet southeast of PW-5. Both production wells are screened in the Fort Pillow Aquifer (PW-4 is \screened at 1,450 feet bls and PW-5 is screened at 1,435 feet bls), with the Flour Island confining unit above the screened intervals.

The potential for ecological and human health effects will be analyzed in detail if contamination is identified at SWMU 20.

6.0 QUALITY ASSURANCE PLAN

The Quality Assurance Plan presented in Section 4.14 of the *Comprehensive RFI Work Plan* will be followed throughout this investigation at SWMU 20.

7.0 DATA MANAGEMENT PLAN

The Data Management Plan presented in Section 5 of the *Comprehensive RFI Work Plan* will be followed during this investigation at SWMU 20.

8.0 HEALTH AND SAFETY PLAN

The Site-Specific Health and Safety Plan for SWMU 20 is included as Appendix A. The Comprehensive Health and Safety Plan is included in Section 7 of the *Comprehensive RFI Work Plan*.

9.0 REFERENCES

EnSafe/Allen & Hoshall (October 1994). *Comprehensive RFI Work Plan for Naval Air Station Memphis*. EnSafe/Allen & Hoshall: Memphis, Tennessee.

ERC/EDGe (September 1990). *RCRA Facility Assessment, NAS Memphis*. ERC/EDGe: Nashville, Tennessee.

National Salvage & Service Corporation (September 1992). *Underground Storage Tank Closure Report, Tank No. 1594*. National Salvage & Service Corp.: Bloomington, Indiana.

Southern Division Naval Facilities Engineering Command (May 1990). *Draft Final RCRA Facility Investigation Work Plan for Naval Air Station-Memphis*. SOUTHDIV: Charleston, South Carolina.

Appendix A
Site-Specific Health and Safety Plan

ASSEMBLY F — RFI WORK PLAN
NAVAL SUPPORT ACTIVITY MEMPHIS
MILLINGTON, TENNESSEE

SITE-SPECIFIC HEALTH AND SAFETY PLAN
SWMU 20
1594 UNDERGROUND WASTE TANK

CTO-106
Contract Number: N62467-89-D-0318

Prepared for:

Department of the Navy
Southern Division
Naval Facilities Engineering Command
North Charleston, South Carolina

Prepared by:

EnSafe/Allen & Hoshall
5720 Summer Trees Drive, Suite 8
Memphis, Tennessee 38134
(901) 383-9115

April 4, 1996

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1.0 INTRODUCTION

A Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) is being conducted at Solid Waste Management Unit (SWMU) 20 which includes Underground Waste Tank (UWT) 1594 at Naval Support Activity (NSA) Memphis, Millington, Tennessee, to assess the nature and extent of potential contamination onsite and to determine if additional action is required to maintain compliance with environmental regulations.

This Site-Specific Health and Safety Plan (SSHSP) is written for field operations to be conducted at SWMU 20. This plan is to be used in conjunction with the approved NSA Memphis Comprehensive Health and Safety Plan (CHASP). Copies of both this plan and the CHASP should be onsite during all field operations.

Applicability

See CHASP Section 7.

Current Hazardous Waste Operations and Emergency Response (HAZWOPER) training certificates for EnSafe/Allen & Hoshall (E/A&H) personnel and all subcontractors anticipated to be conducting fieldwork will be filed onsite and available for review. Individuals whose certifications are not on file, or those who have more recent certificates (have attended refresher courses), will provide the Site Supervisor with copies of their certificates before being allowed to enter a work area.

Current Occupational Safety and Health Administration (OSHA) refresher training certificates will be available onsite for all employees involved in field activities if their refresher course requirements come up for renewal before the project begins. All subcontractors, Navy oversight personnel, and any other site visitors must provide health and safety certification with appropriate refresher course documentation prior to site entry.

2.0 SITE CHARACTERIZATION

2.1 Site Description

SWMU 20 is approximately 200 feet west of Fifth Avenue and C Street on the NSA Memphis Southside, southeast of Building 1594 (Figure 1). SWMU 20 consists of UWT 1594, which reportedly received waste oil and waste hydraulic fluid generated by the Air Traffic Control School. The UWT may also have contained volatile petroleum constituents such as benzene, xylene, and toluene, and heavy metals and polychlorinated biphenyls (PCBs). Data indicate a release may have occurred before UWT 1594 was removed.

2.2 Work Areas

See Section 7.1.1 of the CHASP for a description of the following work zones:

- Exclusion Zone (EZ)
- Contaminant Reduction Zone (CRZ)
- Support Zone (SZ)

Field activities to be conducted onsite and within each work area are described in the Site Investigation Plan.

2.3 Work Area Access

Authorized personnel will be allowed access to work areas as long as they have presented documentation of 40-hour OSHA training under Title 29 Code of Federal Regulations (CFR) Part 1910.120, have signed CHASP and SSHSP plan acceptance forms, and have received a hazard communication briefing from the site health and safety officer or site manager. See also Work Area Access, Section 7.1.2 of the CHASP.

Figure 1 Vicinity Map

2.4 Site Map and Work Zones

Sampling locations at the site are shown in Figure 2. The EZ, CRZ, and SZ locations will be based on physical layout of the site, work task requirements, and current meteorological conditions. When non-investigation personnel are in the vicinity, the EZ will be established using yellow caution tape. Figure 3 shows a typical site work zone setup.

3.0 SITE ACTIVITIES

Site activities will include Geoprobe and hand auger soil and groundwater sampling. Field methods are described in the *Comprehensive RFI Work Plan, Naval Air Station Memphis, Millington, Tennessee* (E/A&H, 1994).

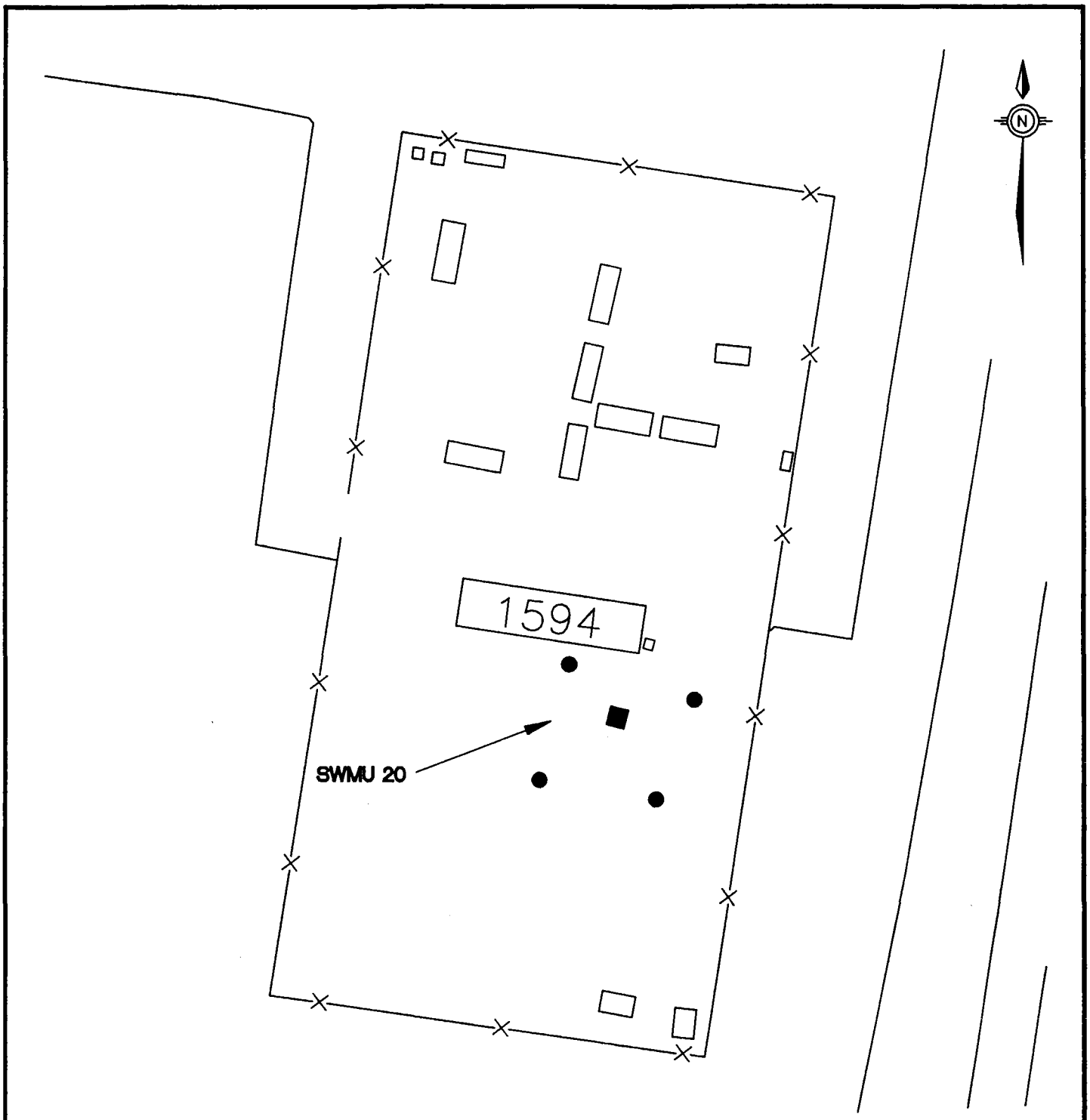
4.0 CHEMICAL HAZARDS

The site history suggests a potential for exposure to chemicals. Table 4-1 lists exposure guidelines for potential site chemicals. Material Safety Data Sheets (MSDSs) for those chemicals are included in Attachment A.

5.0 OPERATIONS AND PHYSICAL HAZARDS

Physical hazards typically encountered during environmental investigations will be present onsite. These hazards include cold or heat-related illnesses, uneven terrain, slippery surfaces, lifting, and use of heavy equipment. The Site Supervisor and Site Health and Safety Officer shall be aware of the potential for heat and/or cold stress and other weather-related illnesses and, as necessary, implement appropriate work regimens to minimize the likelihood of field personnel becoming ill or injured.

Heavy equipment operations will be conducted in accordance with the procedures outlined in the CHASP, Attachment A, Drilling Safety Guide. When conducting operations or survey work on foot, personnel will walk at all times. Running greatly increases the probability of slipping, tripping, and falling. If working in areas supporting habitat for poisonous snakes, personnel should wear protective chaps made of a heavy material designed to prevent snake bites to the legs.



LEGEND

● SAMPLING POINTS

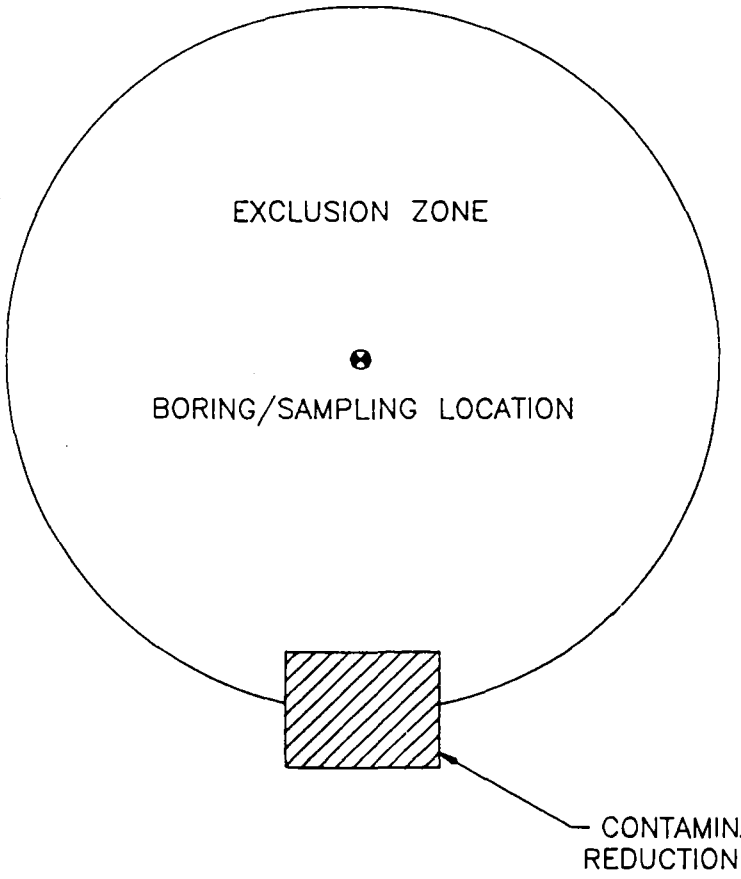
50 0 50

SCALE FEET

RFI WORK PLAN
NSA MEMPHIS
MILLINGTON, TENNESSEE

FIGURE 2
SWMU 20—SAMPLING POINTS

DWG DATE: 03/29/96 | DWG NAME: 94SP20



NOT TO SCALE

RFI WORK PLAN
NSA MEMPHIS
MILLINGTON, TENNESSEE

FIGURE 3
SITE WORK ZONES

DWG DATE: 09/12/95 | DWG NAME: 094SWZ01

Table 4-1
Exposure Guidelines For Expected Site Chemical Hazards

Chemical Name	Odor[a] Threshold (ppm)	OSHA PEL[b] (ppm)	ACGIH TLV[c] (ppm)	NIOSH REL[d] (ppm)	Action Level[e] (ppm)	Flammable range (% by volume)
Toluene	40	100 150 STEL	50	100 150 STEL	25	1.3 to 7.1%
Hydraulic Fluid	N.A.	5 mg/m³	5 mg/m³ 10 mg/m³ STEL	N.A.	2.5 mg/m³	N.A.
PCBs	N.A.	0.5 mg/m³	0.5 mg/m³ 1 mg/m³ Skin	N.A.	0.25 mg/m³	N.A
Cadmium	N.A.	0.05 mg/m³	0.002 mg/m³ - Respirable Fraction 0.01 mg/m³ - Total Dust	Lowest Feasible Concentration	0.01 mg/m³	N.A
Chromium	N.A.	1 mg/m³	1 mg/m³	0.5 mg/m³	0.25 mg/m³	N.A
Lead	N.A.	0.05 mg/m³	0.15 mg/m³	<0.1 mg/m³	0.025 mg/m³	N.A.
Diesel Fuel	N.A.	N.A.	N.A.	N.A.	N.A.	0.7 to 7.5%
Ethylbenzene	140	100 125 STEL	100 125 STEL	N.A.	50	1.0 to 6.7%
Benzene	4.68	1 5 STEL	0.1 Confirmed Human Carcinogen	0.1 1 STEL Potential Occupational Carcinogen	0.05	1.3 to 7.1%
Xylene	Not Listed	100 150 STEL	100 150 STEL	100 150 STEL	50	1.0 to 7.0%

Notes:

[a] — Odor Thresholds for Chemicals with Established Occupational Health Standards, American Industrial Hygiene Association, 1989, Range of All Reference Values.

[b] — 29 CFR 1910.1000, Table Z-1-A. Limits for Air Contaminants, as amended through 1/15/91. (PEL = Permissible Exposure Limit)

[c] — 1990-1991 Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices, American Conference for Governmental Industrial Hygienists (ACGIH). (STEL = Short-Term Exposure Limit)

[d] — National Institute for Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards, June 1990. (REL = Recommended Exposure Limit)
[e] — Action Level is the exposure limit at which personnel will implement engineering controls or upgrade levels of personal protective equipment. The Action Level is based on 50% of the PEL, TLV, or REL, whichever is lower.
N.A. — Substance information not available, or substance unlisted.
mg/m^3 — milligrams per cubic meter
ppm — parts per million

6.0 EMPLOYEE PROTECTION

Employee protection for this project includes standard safe work practices, NSA Memphis rules of conduct, personal protective equipment (PPE), personal decontamination procedures, and equipment for extreme weather conditions, work limitations, and exposure evaluation.

6.1 Standard Safe Work Practices

- Eating, drinking, chewing gum or tobacco, smoking, or any activity that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated as contaminated.

- Hands and face must be thoroughly washed upon leaving the work area.

- No contact lenses will be worn in work areas while invasive actions are conducted.

- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.

- Contact with contaminated or suspected contaminated surfaces should be avoided. Whenever possible, do not walk through puddles, leachate, or discolored surfaces, or lean, sit, or place equipment on drums, containers, or soil suspected of being contaminated.

- Medicine and alcohol can exacerbate the effects from exposure to toxic chemicals. Prescribed drugs should not be taken by personnel on cleanup or response operations where the potential for absorption, inhalation, or ingestion of toxic substances exists unless specifically approved by a qualified physician. Consumption of alcoholic beverages is prohibited.

- Due to the possible presence of overhead power lines, adequate side and overhead clearance should be maintained to ensure that the drill rig boom does not come within 15 feet of any overhead lines.

- Due to the possible presence of underground utilities (including electric, natural gas, water, sewer, telephone, etc.), the activity and local utility representatives should be contacted and requested to identify all lines at the ground surface using characteristic spray paint or labeled stakes. A 3-yard buffer zone should be maintained during all subsurface investigations.

- Due to the flammable properties of the potential chemical hazards, all spark or ignition sources should be bonded and/or grounded or mitigated before soil boring advancement or other site activities begin.

6.2 NSA Memphis General Rules of Conduct

- Liquor, firearms, narcotics, tape recorders, and other contraband items are not permitted on the premises.

- Any violation of local, state, or federal laws, or conduct which is outside the generally accepted moral standards of the community is prohibited.

- Violation of the Espionage Act, willfully hindering or limiting production, or sabotage is not permitted.

- Willfully damaging or destroying property, or removing government records is forbidden.

- Misappropriation or unauthorized alteration of any government records is forbidden.

- Securing government tools in a personal or contractor's tool box is forbidden.

- Gambling in any form, selling tickets or articles, taking orders, soliciting subscriptions, taking up collections, etc. is forbidden.

- Doing personal work in government shop or office, using government property or material for unauthorized purposes, or using government telephones for unnecessary or unauthorized local or long-distance telephone calls is forbidden.

- Compliance with posted signs and notices is required.

- Boisterousness and noisy or offensive work habits, abusive language, or any oral, written, symbolic, or other communicative expression which tends to disrupt the work or morale of others is forbidden.

- Fighting or threatening bodily harm to another is forbidden.

- Defacing any government property is forbidden.

- Wearing shorts of any type and/or offensive logos, pictures, or phrases on clothing is forbidden. Shirts, shoes, and pants, slacks, or coverall-type garments will be worn at all times on government property.

- All persons operating motor vehicles will obey all NSA Memphis traffic regulations.

6.3 Selection of Personal Protective Equipment

It is important that PPE be appropriate to protect against the potential or known hazards at each cleanup or investigation site. Protective equipment will be selected based on the types, concentrations, and routes of personal exposure that may be encountered. In situations where the types of materials and possibilities of contact are unknown or the hazards are not clearly identifiable, a more subjective determination must be made of the PPE required, based on experience and sound safety practices.

The Project Health and Safety Officer will determine the appropriate level of PPE prior to the initial entry based on the chemical(s) of concern, air monitoring levels (i.e., photoionization detector [PID] readings, combustible gas indicator [CGI] readings, or colorimetric tube results), or physical site conditions (i.e., heat stress or cold exposure). PPE requirements are subject to change as site information is updated or changes. **The decision to upgrade or downgrade levels of PPE shall be made by the Project Health and Safety Officer.**

Field activities which disturb soil will be initiated in modified Level D protection except when stated otherwise in the SSHSP or when site conditions (e.g., sampling results from previous studies) indicate that modified Level D is inappropriate. Modified Level D protection consists of a hard hat, appropriate chemical-resistant gloves (vinyl or nitrile), eye protection, and chemical-resistant, steel toe and shank boots. Work coveralls (full length sleeves and pants) will be worn if free product or contaminants identified as skin irritants are encountered. This level

of protection was selected because the contaminant concentrations detected in previous studies were low and free product was not detected.

PPE upgrades to Level C will be initiated if airborne concentrations exceed 2 parts per million (ppm) above the background concentration in the breathing zone or if the concentration of any contaminant exceeds 50% of the OSHA Permissible Exposure Limit (PEL). See Table 6-1 for the specific criteria for use and equipment for each level of protection.

6.4 Air Monitoring

Site history and previous site work indicate that workers may be exposed to low concentrations of numerous chemicals including volatile organic compounds (VOCs), halogenated compounds, and combustible gases/vapors. Based on site history and current sampling data, "worst-case" contaminated areas will be identified before field activities begin.

Air will be monitored using a PID and/or other appropriate sampling equipment prior to beginning field activities at a new EZ and during ground-disturbing activities. The PID will be field calibrated to measure VOCs relative to a 100 ppm isobutylene standard. If VOCs are detected downhole, colorimetric detector tubes and/or other sampling media may be used to identify and approximate the concentrations of these compounds.

A CGI will be used during all soil borings and well installation activities. The CGI will be field calibrated to measure flammable gases relative to a 23% lower explosive limit (LEL) methane standard. Downhole CGI readings will be collected continuously whenever soil is disturbed. Field activities will immediately cease if downhole readings exceed 10% LEL. If CGI readings

Table 6-1
Level Of Protection And Criteria

Level of Protection	Criteria for Use	Equipment
Level A	• When atmospheres are "immediately dangerous to life and health" (IDLH in the NIOSH/OSHA Pocket Guide to Chemical Hazards or other guides). • When known atmospheres or potential situations exist that would affect the skin or eyes or be absorbed into the body through these surfaces. Consult standard references to obtain concentrations hazardous to skin, eyes, or mucous membranes. • Potential situations include those where immersion may occur, vapors may be generated, or splashing may occur through site activities. • Where atmospheres are oxygen deficient with the conditions above. • When the type(s) and or potential concentration of toxic substances are not known.	• Positive pressure-demand full facepiece, self-contained breathing apparatus (SCBA) or positive pressure-demand supplied air respirator with escape SCBA • Totally encapsulating chemical protective suit • Chemical-resistant inner and outer gloves • Steel toe and shank chemical-resistant boots • Hard hat under suit • Two-way radios worn inside suit • Coveralls, long cotton underwear, disposable protective suit, gloves and boots, worn over fully encapsulating suit
Level B	• When work areas contain less than 19.5% oxygen. • When vinyl chloride is detected in the breathing zone.	• Chemical-resistant clothes, long sleeves, hooded, one or two pieces • Full-faced positive-pressure demand supplied air breathing apparatus or airline system with a 30-minute escape bottle • Hard hat • Inner gloves and chemical-resistant gloves • Steel toe and- hank boots • Coveralls and disposable outer boots
Level C	• When airborne dust particles warrant respiratory protection. • When work areas contain at least 19.5% oxygen.	• Chemical-resistant clothes, long sleeves, hood optional, one or two pieces • Full-face piece, air purifying respirator equipped with cartridges suitable for the hazard • Hard hat • Inner gloves and chemical-resistant gloves • Steel toe and shank boots • Coveralls and disposable outer boots
Level D	• When level B or C is not indicated. • When airborne particles do not warrant respiratory protection. • When work areas contain at least 19.5% oxygen.	• Inner gloves and chemical-resistant gloves needed to handle soil or water samples • Steel toe and shank boots • Hard hat (ANSI Z891-1969 standard) • Eye protection (ANSI Z87.1-1968) standard • Sunscreen (SPF 15 or greater) • Coveralls and disposable outer boots

Notes:
ANSI — American National Standards Institute.
Level A protection will be selected when the highest available level of respiratory, skin, and eye protection is needed. Level A protection will be required in Area A of the exclusion zone.

Contraindications for use of Level A:
- Environmental measurements contiguous to the site indicate that air contaminants do not represent a serious dermal hazard.
- Reliable, accurate historical data do not indicate the presence of severe dermal hazards.
- Open, unconfined areas.
- Minimal probability of vapors or liquids (splash hazards) present which could affect or be absorbed through the skin.
- Total vapor readings indicate 500 ppm to 1,000 ppm.

Level B protection will be selected when the highest level of respiratory protection is needed, but cutaneous exposure to the small unprotected areas of the body (neck and back of head) is unlikely, or where concentrations are not known to be within acceptable standards. Additionally, the permissible limit for exposure to mixtures of all site gases will be checked using the requirements of 1910.1000(d)(2)(i) to ensure that PEL is not exceeded. If the value calculated using this method exceeds 1.0, Level B PPE is required.

Level C protection will be selected when the types and concentrations of inseparable material are known, or reasonably assumed to be no greater than the protection factors associated with air-purifying respirators, and exposure to the unprotected areas of the body is unlikely to cause harm. Dust concentrations require Level C PPE, where the respirable fractions exceed the PEL of 5 milligrams per cubic meter (mg/m^3) or the total concentrations exceed the PEL of 15 mg/m^3.

Level D protection will be chosen when measurements of atmospheric concentrations are at background levels and work functions preclude splashes, immersion, or the potential for unexpected inhalation or contact with hazardous concentrations of any chemicals.

do not subside, the area will be carefully investigated and mapped. Operations may not proceed until readings are below 10% LEL. The area will be immediately evacuated and the situation re-evaluated to determine how to proceed.

If breathing zone concentrations exceed 2 ppm above background or site conditions indicate that additional health and safety precautions are needed, field activities in the area shall stop. Field staff shall notify the Site Supervisor of the situation and he/she shall contact both the Project Manager and the Project Health and Safety Officer. The Project Health and Safety Officer will be responsible for reassessing the hazards and prescribing revised health and safety requirements as necessary, including upgraded PPE requirements, revised work schedules, and revised decontamination procedures. (Typically, PPE will be upgraded to Level C assuming that cartridge respirators are appropriate, otherwise Level B.) See Table 6-1 for specific criteria for each protection level. Work shall not proceed until breathing zone concentrations return to background levels and it is reasonably anticipated that breathing zone samples will stay

approximately at background, or the chemical constituent(s) are identified and appropriate PPE is donned.

Field monitoring values will be recorded in a field logbook and copies must be posted for field personnel review.

PIDs, CGIs, and other monitoring equipment shall be calibrated daily or their proper function verified before being used. Throughout the day this equipment shall be periodically checked to ensure that it is working properly. A final calibration shall be conducted at the end of the workday, at which time each instrument will be checked to ensure that it is free from surface contamination. Field staff shall note in their field notebooks that they conducted these calibrations and checks and note whether the equipment functioned properly. Malfunctioning equipment should be brought to the attention of the Site Supervisor or Site Health and Safety Officer, who will arrange to repair and/or replace that equipment as needed.

6.5 Procedures and Equipment for Extreme Hot or Cold Weather Conditions

See CHASP Section 7.5.5.

Severe Weather Conditions

All fieldwork shall immediately cease at the first sign of thunder or lightning. Field personnel shall perform emergency personal and equipment decontamination (see Section 6.6) and seek immediate shelter.

6.6 Personal Decontamination

A CRZ will be established immediate to each sampling/boring site and will include a station for decontaminating equipment and personnel. The CRZ will be covered with sheets of 6-mil polyethylene (typically an area 20 feet x 20 feet is sufficient) with specific stations that will

accommodate the removal and disposal of the protective clothing, boot covers, gloves, and respiratory protection, if required.

As a general rule, equipment will be decontaminated using a soap and clean water wash solution. Equipment decontamination will be completed by personnel in Level D PPE. In extreme weather (e.g., lightning) or an emergency requiring immediate evacuation, all contaminated equipment will be wrapped and taped in 6-mil polyethylene sheeting and tagged as "contaminated" for later decontamination.

Personnel working in the CRZ will be in one Level of PPE lower than personnel in the EZ. For example, if personnel in the EZ are in Level B, decontamination workers will be in Level C.

6.6.1 Personal Decontamination Procedures

The decontamination procedures, based on Level D protection, will consist of:

- Brushing heavily soiled boots and rinsing outer gloves and boots with soap and water.
- Removing outer gloves and depositing them in a labeled plastic-lined container.
- Removing outer chemical-protective clothing.
- Washing and rinsing inner gloves.
- Thoroughly washing hard hats and eye protection at the end of each workday with a soap and water solution.
- Discarding disposable gloves and other disposable clothing in resealable bags and placing them in a labeled 55-gallon drum for disposal onsite.

- All field personnel are to be instructed to shower as soon as possible after leaving the site.

Decontamination procedures will be conducted at the lunch break and at the end of each workday. If higher levels of PPE are needed, these procedures will be adjusted and this SSHSP will be amended.

All wastes (soil and water) generated during personal decontamination will be collected in 55-gallon drums, labeled, and staged for final disposal.

6.6.2 Closure of the Personal Decontamination Station

All disposable clothing and plastic sheeting used during site activities will be double-bagged and discarded in a refuse container. Decontamination and rinse solutions will be placed in 55-gallon drums and labeled for later analysis and disposal. All washtubs, pails, buckets, etc. will be washed, rinsed, and dried at the end of each workday.

6.7 Work Limitations

All site activities will be conducted during daylight only. All personnel scheduled for these activities will have completed initial health and safety training and actual field training as specified in 29 CFR 1910.120(e). All supervisors must complete an additional eight hours of training in site management. All personnel must complete an eight-hour refresher training course annually to continue working onsite.

6.8 Exposure Evaluation

All personnel scheduled for site activities will have had baseline physical examinations which include stressing exams of the neurologic, cardiopulmonary, musculoskeletal and dermatological systems; pulmonary function testing; multichemistry panel; and urinalysis, and have been declared fit for duty. An exposure history form will be completed for each worker participating

in site activities. An examination and updated occupational history will be repeated annually and upon termination of employment, as required by 29 CFR 1910.120(f). The content of the annual or termination examination will be the same as the baseline physical. A qualified physician will review the results of the annual examination and exposure data and request further tests or issue medical clearances as appropriate.

After any job-related injury or illness, a medical examination determine fitness for duty or whether any job restrictions are needed. The Site Health and Safety Officer will review the results with the examining physician before releasing the employee for work. A similar examination will be performed if an employee has missed at least three days of work due to a non-job-related injury or illness requiring medical attention. Medical records shall be maintained by the employer or the physician for at least 30 years following the termination of employment.

7.0 MEDICAL MONITORING PROGRAM

See CHASP Section 7.6.

8.0 AUTHORIZED PERSONNEL

Personnel anticipated to be onsite at various times during site activities include:

• Principal-in-Charge	Dr. James Speakman (E/A&H)
• Task Order Manager/Project Manager	Mr. Lawson Anderson (E/A&H)
• Project Health and Safety Officer	Mr. Doug Petty (E/A&H)
• Site Supervisor	Mr. Jim Rathbone (E/A&H)
• Site Health and Safety Officer	Mr. Jim Rathbone (E/A&H)
• Engineer-in-Charge (EIC)	Mr. Mark Taylor (SOUTHDIV)
• NSA Memphis Site Contact	Ms. Tonya Barker

8.1 Responsibilities of Site Supervisor

The Site Supervisor will direct the site operations and, relative to health and safety, is responsible for ensuring that:

- Field staff follow the CHASP, SSHSP, and other safety and health standard operating procedures. Personnel who do not comply are retrained and/or instructed to leave the site and not allowed to return.

- Field staff have current HAZWOPER training.

- Field staff know who the Site Health and Safety Officer is.

- Field staff know the site-specific safety and health concerns.

- The onsite supply of health and safety equipment is adequate.

- Field staff participate in the E/A&H medical surveillance program (or subcontractors, an equivalent program).

- Field staff attend safety and health "kick-off" orientation and other site safety briefings.

The Site Supervisor is also responsible for ensuring that field staff who may be exposed to unique or special hazards have the training or experience necessary to safely conduct their work.

8.2 Responsibilities of Site Health and Safety Officer

The responsibilities of the Site Health and Safety Officer include:

- Providing the Site Supervisor technical input on site health and safety issues.

- Observing field personnel and reporting to the Site Supervisor on the effectiveness of the CHASP and SSHSP and whether field staff are using proper work practices and decontamination procedures.
- Reporting significant safety violations to the Project Manager and/or Project Health and Safety Officer.
- Conducting safety briefings during field activities.
- Ensuring that copies of the CHASP and SSHSP are maintained onsite during all field activities.
- Maintaining a file of HAZWOPER training certificates and appropriate refresher training certificates for onsite personnel.

The Site Health and Safety Officer will have the following qualifications: (1) 40 of hours OSHA training or equivalent experience, (2) 24 hours of supervisory training or equivalent experience, (3) knowledge of the health and safety concerns for the specific tasks being conducted, and (4) trained to use the air monitoring equipment; able to interpret the data collected with the instruments; familiar with symptoms of chemical exposure, heat stress, and cold exposure; and knows the location and proper use of onsite safety equipment. He will also be familiar with the CHASP and SSHSP.

The position of Site Health and Safety Officer may rotate. Often, particularly on small projects, this function is not a full-time responsibility, rather a member of the field team is selected to serve as the alternate Site Health and Safety Officer. Then when that task is completed and/or field staff change, the alternate Site Health and Safety Officer may change as well. The alternate Health and Safety Officer must meet the criteria for the Site Health and Safety Officer listed above.

The following criteria outline when the Site Health and Safety Officer will be replaced: (1) termination of employment, (2) end of work task, (3) end of shift, (4) sickness, (5) injury, or (6) death. It should be noted that under site work schedules only one shift will be working. As a result, the Site Health and Safety Officer will be responsible for the day shift. If circumstances arise that require work during other periods, an alternate Site Health and Safety Officer will be designated.

8.3 Responsibilities of Onsite Field Staff

The health and safety responsibilities of field staff include:

- Being familiar with and complying with this CHASP and SSHSP.
- Attending site health and safety briefings and being aware of anticipated chemical, physical, and biological hazards and what to do when these hazards are encountered.
- Being properly trained on PPE to be used, safe work practices, decontamination procedures to be followed, and emergency procedures and communications.
- Using required PPE including respiratory protection.
- Having up-to-date HAZWOPER training and providing the Site Supervisor with documentation that training is current.
- Being an up-to-date participant in an acceptable medical surveillance program.
- Being fit-tested and physically capable of using a respirator and being in a position where using a respirator may be a requirement. Should the use of respiratory protection be

required, field workers shall not have facial hair which intrudes into the respirator's sealing surface.

- Using the buddy system when wearing respiratory protective equipment. When working in Level C or higher, a third person shall be at the work area. This person shall be suitably equipped to provide logistical and safety support to the entry team.

In addition, field staff should always be alert and use their senses (sight, smell, etc.) to identify and react to potentially hazardous situations. When working in the EZ, visual contact should be maintained between personnel; field personnel should be close enough to assist each other during an emergency. Procedures for leaving a contaminated area must be planned and implemented before going onsite, in accordance with the CHASP and SSHSP.

The number of personnel and the amount of equipment in the contaminated area should be kept to a minimum, consistent with effective site operations. All visitors to the job site must comply with the CHASP and SSHSP procedures. PPE may be modified for visitors depending on the situation. Modifications must be approved by the Project Health and Safety Officer.

9.0 EMERGENCY INFORMATION

All hazardous waste site activities present a risk to onsite personnel. During routine operations risk is minimized by establishing good work practices, staying alert, and using proper PPE. Unpredictable events such as physical injury, chemical exposure, or fire may occur and must be anticipated.

If any situation or unplanned occurrence requires outside or support service, Tonya Barker, NSA Memphis Site Contact, will be informed and the appropriate contact from the following list will be made:

Contact	Agency or Organization	Telephone
Tonya Barker	NSA Memphis	(901) 873-5461/5462
Mark Taylor	SOUTHDIV EIC	(803) 743-0573
Law Enforcement	NSA Memphis Base Security	9-911
Fire Department	NSA Memphis	9-911
Ambulance Service	Naval Hospital, Millington Navy Road	(901) 873-5801/5802 or 9-911
Hospital	Methodist North Hospital 3960 Covington Pike	(901) 372-5211 or 9-911
Southern Poison Control Center	—	(901) 528-6048
Lawson Anderson	EnSafe/Allen & Hoshall	(901) 372-7962
Doug Petty	EnSafe/Allen & Hoshall	(901) 372-7962

Mark Taylor, SOUTHDIV EIC, will be contacted after appropriate emergency measures have been initiated onsite.

9.1 Site Resources

Cellular telephones or the telephone at the nearby Aircraft Fire Fighting Training Facility trailer are available for emergency use and communication/coordination with NSA Memphis. First-aid and eye wash equipment will be available at the work area.

9.2 Emergency Procedures

Conditions that may constitute an emergency include any member of the field crew being involved in an accident or experiencing any adverse effects or symptoms of exposure while

onsite, or if a condition is identified that suggests the existence of a situation more hazardous than anticipated.

The following emergency procedures should be followed:

- Site work area entrance and exit routes will be planned and emergency escape routes delineated by the Site Health and Safety Officer. Copies of emergency contacts and routes will be posted onsite.

- If any member of the field team experiences any effects or symptoms of exposure while on the scene, the entire field crew will immediately stop work and act according to the instructions of the Site Health and Safety Officer.

- For applicable site activities, wind indicators visible to all onsite personnel will be provided by the Site Health and Safety Officer to indicate possible routes for upwind escape.

- The discovery of any conditions that would suggest a situation is more hazardous than anticipated will result in the suspension of work until the Site Health and Safety Officer has evaluated the situation and provided the appropriate instructions to the field team.

- If an accident occurs, the Field Project Manager is to complete an Accident Report Form (see Attachment B) for submittal to the managing principal-in-charge of the project.

- If a member of the field crew suffers a personal injury, the Site Health and Safety Officer will call **(901) 372-5211 or 9-911** (serious injury) to alert appropriate emergency response agencies or administer onsite first aid (minor injury) as the situation dictates. An Accident Report Form will be completed for any such incident.

- If a member of the field crew suffers chemical exposure, the affected areas should be flushed immediately with copious amounts of clean water, and if the situation dictates, the Site Health and Safety Officer should alert appropriate emergency response agencies, or personally ensure that the exposed individual is transported to the nearest medical treatment facility for prompt treatment. (See Attachment C for directions.) An Accident Report Form will be completed for any such incident.

Additional information on appropriate chemical exposure treatment methods will be provided through MSDSs in Attachment A.

10.0 FORMS

The following forms will be used to implement this SSHSP:

- Plan Feedback Form
- Exposure History Form
- Accident Report Form

The Plan Acceptance Form will be filled out by all employees working onsite before site activities begin. The Plan Feedback Form will be filled out by the Site Health and Safety Officer and any other onsite employee who wishes to fill one out. The Exposure History Form will be completed by both the Field Project Manager and the individual(s) for whom the form is intended. Examples of each form are provided in Attachment B of this plan.

All completed forms must be returned to the Task Order Manager at EnSafe/Allen & Hoshall, Memphis, Tennessee.

ATTACHMENT A
MATERIAL SAFETY DATA SHEETS

CHEMTOX DATA

---------- IDENTIFIERS ----------

CHEMTOX RECORD 398 LAST UPDATE OF THIS RECORD: 11/24/95

NAME: TOLUENE

SYNONYMS: TOLUOL; PHENYL METHANE; METHYL BENZENE; BENZENE, METHYL-

CAS: 108-88-3 RTECS: XS5250000

FORMULA: C7H8 MOL WT: 92

WLN: 1R

CHEMICAL CLASS:Aromatic hydrocarbon

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION: colorless watery liquid with a sweet, pungent, benzene-like odor

BOILING POINT:	383.6 K	110.4 C	230.8 F
MELTING POINT:	178.00 K	-95.2 C	-139.3 F
FLASH POINT:	277.6 K	4.45 C	40 F
AUTO IGNITION:	809 K	535.8 C	996.6 F
CRITICAL TEMP:	591.8 K	318.65 C	605.57 F
CRITICAL PRESS:	4.108 kN/M2	40.5 atm	595 psia
HEAT OF VAP:	155 Btu/lb	86.08 cal/g	3.601x E5 J/kg
HEAT OF COMB:	-17430 Btu/lb	-9690 cal/g	-405x E5 J/kg

VAPOR PRESSURE: 21 mm @ 20 C

UEL: 7.1 %

LEL: 1.3 %

IONIZATION POTENTIAL (eV): 8.82

VAPOR DENSITY: 3.14 (air=1)

EVAPORATION RATE: 2.00(n-BUTYL ACETATE=1)

SPECIFIC GRAVITY: 0.867 @ 20 C

DENSITY: 0.867

WATER SOLUBILITY: 0.05%

INCOMPATIBILITIES: strong ox

REACTIVITY WITH WATER: No data on water reactivity

REACTIVITY WITH COMMON MATERIALS: No data

STABILITY DURING TRANSPORT: No Data

NEUTRALIZING AGENTS: No data

POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: None reported other than possible unburned vapors

ODOR DETECTED AT (ppm): 40 PPM

ODOR DESCRIPTION: STRONG, PLEASANT Source:NYDH

100 % ODOR DETECTION: No data

---------- REGULATIONS ----------

DOT hazard class: 3 FLAMMABLE LIQUID
DOT guide: 27
Identification number: UN1294
DOT shipping name: Toluene
Packing group: II
Label(s) required: FLAMMABLE LIQUID
Special provisions: T1
Packaging exceptions: 173.150
Non bulk packaging: 173.202
Bulk packaging: 173.242
Quantity limitations-
Passenger air/rail: 5 L
Cargo aircraft only: 60 L
Vessel stowage: B
Other stowage provisions:

STCC NUMBER: 4909305

CLEAN WATER ACT Sect.307:Yes
CLEAN WATER ACT Sect.311:Yes
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 1 mg/L (07/30/92)
Maximum Contaminant Level Goals (MCLG): 1 mg/L (07/30/92)
CLEAN AIR ACT: CAA '90 Listed
EPA WASTE NUMBER: U220,D001
CERCLA REF: Not listed
RQ DESIGNATION: C 1000 pounds (454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Acute toxicity: Irritant
Acute toxicity: adverse effect to target organs.
Chronic toxicity: adverse effect to target organ after long period of exposure.
Chronic toxicity: mutagen.
Chronic toxicity: reproductive toxin.

Fire hazard: flammable.
Chronic toxicity: carcinogen
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 1.0 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: Flammable liquid - Mailable as ORM-D
Mailability: Domestic surface mail only
Max per parcel: 1 QT METAL; 1 PT OTHER

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.

REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON ----------

ACGIH TLV list "Threshold Limit Values for 1992-1993"
ATSDR Toxicology Profile available (NTIS** PB/90/198904/AS)
California Assembly Bill 1803 Well Monitoring Chemicals.
California Assembly Bill 2588 Air Toxics "Hot Spots" Chemicals.
California Department of Health Services Drinking Water Action List.
California Proposition 65 Developmental Toxin List
Canadian Domestic Substances List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
Clean Air Act Section 111 List.
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 307 Priority Pollutants
Clean Water Act Section 311 Hazardous Chemicals List.
DOT Hazardous Materials Table. 49 CFR 172.101
EPA Carcinogen Assessment Group List
EPA List of VOC chemicals from 40 CFR 60.489
EPA TSCA 8(a) Preliminary Assessment Information Rule - effective 11/19/82
EPA TSCA 8(d) Health and Safety Data Rule - effective date 10/04/82
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
Massachusetts Substance List.
New Jersey Right To Know Substance List. (December 1987)
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
OSHA Process Safety Rule chemical with a TQ. Effective May 26, 1992
Pennsylvania Hazardous Substance List
RCRA Hazardous Constituents for Ground Water Monitoring. Ap'dx IX to 40 CFR 264
RCRA Hazardous Waste
SARA Section 110 Priority List of CERCLA Hazardous Substances
SARA Section 313 Toxic Chemicals List
Superfund/CERCLA RQ list. Table 302.4 in 54 FR 50968 (December 11, 1989)
TOLUENE [108-88-3]
Washington State Discarded Chemical Products List, November 17, 1989
Wisconsin Air Toxics Control Regulation NR-445 (December 1988)

---------- TOXICITY DATA ----------

SHORT TERM TOXICITY: INHALATION: 100 ppm exposure can cause dizziness, drowsiness and hallucinations. 100-200 ppm can cause depression. 200-500 ppm can cause headaches, nausea, loss of appetite, loss of energy, loss of coordination and coma. in addition to the above, death has resulted from exposure to 10,000 ppm for an unknown time. SKIN: can cause dryness and irritation.

absorption may cause or increase the severity of symptoms listed above. Eyes: can cause irritation at 300 ppm. INGESTION: can cause a burning sensation in the mouth and stomach, upper abdominal pain, cough, hoarseness, headache, nausea, loss of appetite, loss of energy, loss of coordination and coma.(NYDH)

LONG TERM TOXICITY: levels below 200 ppm may produce headache, tiredness and nausea. from 200 to 750 ppm symptoms may include insomnia, irritability, dizziness, some loss of memory, loss of appetite, a feeling of drunkeness and disturbed menstruation. levels up to 1,500 ppm may cause heart palpitations and loss of coordination. blood effects and anemia have been reported but are probably due to contamination by benzene. most of these effects area believed to go away when exposure stops.(NYDH)

TARGET ORGANS: CNS, liver, kidneys, skin, eyes, resp sys

SYMPTOMS: Vapors irritate eyes and upper respiratory tract; cause dizziness, headache, anesthesia, respiratory arrest. Liquid irritates eyes and causes drying of skin. If aspirated, causes coughing, gagging, distress, and rapidly developing pulmonary edema. If ingested causes vomiting, griping, diarrhea, depressed respiration. Source: CHRIS

CONC IDLH: 500ppm

NIOSH REL: 100 ppm Time weighted averages for 8-hour exposure
375 mg/M3 Time weighted averages for 8-hour exposure
200 ppm Ceiling exposures which shall at no time be exceeded(10-MIN) 750 mg/M3 Ceiling exposures which shall at no time be exceeded(10-MIN)

ACGIH TLV: TLV = 50ppm(188 mg/M3) Skin
ACGIH STEL: Not listed

OSHA PEL: Transitional Limits:
PEL = 200 PPM; CEILING = 300 PPM; MAXIMUM PEAK ABOVE CEILING
Final Rule Limits:
TWA = 100 ppm (375 mg/M3)
STEL = 150 ppm(560 mg/M3)

MAK INFORMATION: 50 ppm
190 mG/M3
Substance with systemic effects, onset of effect less than or equal to 2 hrs: Peak = 5xMAK for 30 minutes, 2 times per shift of 8 hours.
There is no reason to fear a risk of damage to the developing embryo or fetus when MAK values are adhered

to.

CARCINOGEN?: N STATUS: See below

CARCINOGEN LISTS:

IARC: Not classified as to human carcinogenicity or probably not carcinogenic to humans.
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)

* orl-hmn LDLo:50 mg/kg YAKUD5 22,883,80

ihl-hmn TCLo:200 ppm JAMAAP 123,1106,43
BRAIN AND COVERINGS
Recordings from specific areas of CNS
BEHAVIORAL
Antipsychotic
BLOOD
Changes in bone marrow not included above

LD50 value: orl-rat LD50:636 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:636 mg/kg
ihl-rat LC50:>26700 ppm/1H
ipr-rat LD50:1332 mg/kg
ivn-rat LD50:1960 mg/kg
unr-rat LD50:6900 mg/kg
ihl-mus LC50:400 ppm/24H
ipr-mus LD50:59 mg/kg
scu-mus LD50:2250 mg/kg
unr-mus LD50:2 gm/kg
ihl-rbt LCLo:55000 ppm/40M
skn-rbt LD50:12124 mg/kg
ivn-rbt LDLo:130 mg/kg
ihl-gpg LCLo:1600 ppm
ipr-gpg LD50:500 mg/kg
scu-frg LDLo:920 mg/kg
ipr-mam LDLo:1750 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)

ihl-rat TCLo:1500 mg/m3/24H (1-8D preg) TXCYAC 11,55,78
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:1000 mg/m3/24H (7-14D preg) FMORAO 28,286,80
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:800 mg/m3/6H (14-20D preg) BJMRDK 23,533,90
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
EFFECTS ON NEWBORN
Behavioral

orl-mus TDLo:9 gm/kg (6-15D preg) TJADAB 19,41A,79
EFFECTS ON EMBRYO OR FETUS
Fetal death

orl-mus TDLo:15 gm/kg (6-15D preg) TJADAB 19,41A,79
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

orl-mus TDLo:30 gm/kg (6-15D preg) TJADAB 19,41A,79
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Craniofacial(including nose and tongue)

ihl-mus TCLo:500 mg/m3/24H (6-13D preg) TXCYAC 11,55,78
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-mus TCLo:1000 ppm/6H (2-17D preg) TJEMDR 7,265,82
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-mus TCLo:400 ppm/7H (7-16D preg) FAATDF 6,145,86
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system
EFFECTS ON NEWBORN

ihl-mus TCLo:200 ppm/7H (7-16D preg) FAATDF 6,145,86
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Urogenital system

ihl-rbt TCLo:1 gm/m3/24H (7-20D preg) ATSUDG 8,425,85
EFFECTS ON FERTILITY
Abortion

ihl-rbt TDLo:100 ppm/6H (6-18D preg) ARTODN 66,373,92

SPECIFIC DEVELOPMENTAL ABNORMALITIES
Cardiovascular(circulatory)system

California Prop 65: Developmental toxin (01/01/91)
Acceptable intake level-inhalation 13000. ugD (01/01/94)
Acceptable intake level-oral intake 7000. ugD (01/01/94)

---------- EPA's IRIS DATA SUMMARY ----------
Toluene; CASRN 108-88-3 (04/01/92)

_II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Toluene
CASRN -- 108-88-3
Last Revised -- 08/01/90

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quantitative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

__II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

___II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- D; not classified

Basis -- No human data and inadequate animal data. Toluene did not produce positive results in the majority of genotoxic assays.

___II.A.2. HUMAN CARCINOGENICITY DATA

None.

___II.A.3. ANIMAL CARCINOGENICITY DATA

A chronic (106-week) bioassay of toluene in F344 rats of both sexes reported no carcinogenic responses (CIIT, 1980). A total of 960 rats were exposed by inhalation for 6 hours/day, 5 days/week to toluene at 0, 30, 100, or 300 ppm. Groups of 20/sex/dose were sacrificed at 18 months. Gross and microscopic examination of tissues and organs identified no increase in neoplastic tissue or tumor masses among treated rats when compared with controls. The study is considered inadequate because the highest dose administered was well below the MTD for toluene and because of the high incidence of lesions and pathological changes in the control animals.

Several studies have examined the carcinogenicity of toluene following repeated dermal applications. Toluene (dose not reported) applied to shaved interscapular skin of 54 male mice (strains A/He, C3HeB, SWR) throughout their lifetime (3 times weekly) produced no carcinogenic response (Poel, 1963). One drop of toluene (about 6 mL) applied to the dorsal skin of 20 random-bred albino mice twice weekly for 50 weeks caused no skin papillomas or carcinomas after a 1-year latency period was allowed (Coombs et al., 1973). No increase in the incidence of skin or systemic tumors was demonstrated in male or female mice of three strains (CF, C3H, or CBaH) when toluene was applied to the back of 25 mice of each sex of each strain at 0.05-0.1 mL/mouse, twice weekly for 56 weeks (Doak et al., 1976). One skin papilloma and a single skin carcinoma were reported among a group of 30 mice treated dermally with one drop of 0.2% (w/v) solution toluene twice weekly, administered from droppers delivering 16-20 uL per drop for 72 weeks (Lijinsky and Garcia, 1972). It is not reported whether evaporation of toluene from the skin was prevented during these studies.

___II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

Toluene was found to be nonmutagenic in reverse mutation assays with S. typhimurium (Mortelmans and Riccio, 1980; Nestmann et al., 1980; Bos et al., 1981; Litton Bionetics, Inc., 1981; Snow et al., 1981) and E. coli (Mortelmans and Riccio, 1980), with and without metabolic activation. Toluene did not induce mitotic gene conversion (Litton Bionetics, Inc., 1981; Mortelmans and Riccio, 1980) or mitotic crossing over (Mortelmans and Riccio, 1980) in S. cerevisiae. Although Litton Bionetics, Inc. (1981) reported that toluene did not cause increased chromosomal aberrations in bone marrow cells, several Russian studies (Dobrokhotov, 1972; Lyapkalo, 1973) report toluene as effective in causing chromosal damage in bone marrow cells of rats. There was no evidence of chromosomal aberrations in blood lymphocytes of workers exposed to toluene only (Maki-Paakkanen et al., 1980; Forni et al., 1971), although a slight increase was noted in workers exposed to toluene and benzene (Forni et al., 1971; Funes-Craviota et al., 1977). This finding is supported by studies of cultured human lymphocytes exposed to toluene in vitro; no elevation of chromosomal aberrations or sister chromatid exchanges was observed (Gerner-Smidt and Friedrich, 1978).

__II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

Not available.

__II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

Not available.

__II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

___II.D.1. EPA DOCUMENTATION

U.S. EPA. 1987. Drinking Water Criteria Document for Toluene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Drinking Water, Washington, DC. ECAO-CIN-408.

___II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The values in the 1987 Drinking Water Criteria Document for Toluene have received peer and administrative review.

Agency Work Group Review: 09/15/87

Verification Date: 09/15/87

___II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

Dharm V. Singh / ORD -- (202)260-5958 / FTS 260-5958

Robert E. McGaughy / ORD -- (202)260-5898 / FTS 260-5898

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly when skin becomes wet.

** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammability

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
NIOSH (TOLUENE)
1000 ppm: Any chemical cartridge respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any supplied-air respirator. * Substance reported to cause eye irritation or damage may require eye protection. / Any powered air-purifying respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus. * Substance reported to cause eye irritation or damage may require eye protection.
2000 ppm: Any supplied-air respirator operated in a continuous flow mode. * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus with a full facepiece. / Any supplied-air respirator with a full facepiece. / Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister.
EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.: Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID SOURCE: NIOSH
EYE: irr immed
SKIN: soap wash promptly
INHALATION: art resp
INGESTION: no vomit

FIRST AID SOURCE: CHRIS Manual 1991
INHALATION: remove to fresh air, give artificial respiration and oxygen

if needed; call a doctor.
INGESTION: do NOT induce vomiting; call a doctor.
EYES: flush with water for at least 15 min.
SKIN: wipe off, wash with soap and water.

FIRST AID SOURCE: DOT Emergency Response Guide 1990.
Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

---------- INITIAL INCIDENT RESPONSE ----------

FIRE EXTINGUISHMENT: Carbon dioxide or dry chemical for small fires, ordinary foam for large fires. Note: Water may be ineffective CHRIS91

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: Toluene
DOT ID NUMBER: UN1294

ERG93 GUIDE 27

POTENTIAL HAZARDS

*FIRE OR EXPLOSION
Flammable/combustible material; may be ignited by heat, sparks or flames.
Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.
Vapor explosion hazard indoors, outdoors or in sewers.
Runoff to sewer may create fire or explosion hazard.
Material may be transported hot.
*HEALTH HAZARDS
May be poisonous if inhaled or absorbed through skin.
Vapors may cause dizziness or suffocation.
Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind; keep out of low areas. Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection. *Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC AT 1-800-424-9300. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until

well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

*SPILL OR LEAK

Shut off ignition sources; no flares, smoking or flames in hazard area. Stop leak if you can do it without risk. Water spray may reduce vapor; but it may not prevent ignition in closed spaces.

Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.

Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

CHEMTOX DATA

---------- IDENTIFIERS ----------

CHEMTOX RECORD 2264 LAST UPDATE OF THIS RECORD: 11/24/95

NAME: OIL MIST, MINERAL

SYNONYMS: NUJOL ; MIST OF WHITE MINERAL OIL; CUTTING OIL; HEAT-TREATING OIL; HYDRAULIC OIL; CABLE OIL; LUBRICATING OIL

CAS: 8012-95-1 RTECS: XH7480000

FORMULA: W99 MOL WT: N.A.

WLN:

CHEMICAL CLASS: Paraffin

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION: colorless, oily liquid aerosol dispersed in air. has an odor like burned lubricating oil.

BOILING POINT:	633.15 K	360 C	680 F
MELTING POINT:	255.37 K	-17.8 C	-.1 F
FLASH POINT:	466.48 K	193.33 C	379.9 F
AUTO IGNITION:	Not available		
VAPOR PRESSURE:	<0.5 mmHg @ 20 C		
UEL:	N.A.		
LEL:	N.A.		
VAPOR DENSITY:	No data		
SPECIFIC GRAVITY:	0.90		
DENSITY:	0.83		
WATER SOLUBILITY:	INSOLUBLE		
INCOMPATIBILITIES:	none hazardous		

REACTIVITY WITH WATER: No data on water reactivity

REACTIVITY WITH COMMON MATERIALS: No data

STABILITY DURING TRANSPORT: No Data

NEUTRALIZING AGENTS: No data

POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: None reported other than possible unburned vapors

ODOR DETECTED AT (ppm): Unknown

ODOR DESCRIPTION: No data

100 % ODOR DETECTION: No data

---------- REGULATIONS ----------

DOT hazard class: Not given

DOT guide:

Identification number:

DOT shipping name:

Packing group:
Label(s) required:
Special provisions:
Packaging exceptions: 173.
Non bulk packaging: 173.
Bulk packaging: 173.
Quantity limitations-
Passenger air/rail:
Cargo aircraft only:
Vessel stowage:
Other stowage provisions:

STCC NUMBER: Not listed

CLEAN WATER ACT Sect.307:No
CLEAN WATER ACT Sect.311:No
CLEAN AIR ACT: Not listed
EPA WASTE NUMBER: None
CERCLA REF: Not listed
RQ DESIGNATION: Not listed
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Acute toxicity: Irritant
Fire hazard: combustible.

UNITED STATED POSTAL SERVICE MAILABILITY:
Not given

NFPA CODES:
HEALTH HAZARD (BLUE): (0) No unusual health hazard.
FLAMMABILITY (RED) : (1) This material must be preheated before ignition can occur.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON ----------

ACGIH TLV list "Threshold Limit Values for 1992-1993"
Canadian Domestic Substances List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
Massachusetts Substance List.
New Jersey Right To Know Substance List. (December 1987)
OIL MIST, MINERAL [8012-95-1]

OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.

---------- TOXICITY DATA ----------

SHORT TERM TOXICITY: ASPIRATION PNEUMONIA, CARCINOGEN OF SKIN AND SCROTUM.
** Source: 2

LONG TERM TOXICITY: unknown

TARGET ORGANS: eyes, skin, resp sys

SYMPTOMS: INHALATION, CONTACT: irrit eyes, skin, resp sys
Source: NIOSH

CONC IDLH: 2500mg/M3

NIOSH REL:

ACGIH TLV: TLV = 5mg/M3
ACGIH STEL: STEL = 10 mg/M3

OSHA PEL: Transitional Limits:
PEL = 5mg/M3
Final Rule Limits:
TWA = 5 mg/M3

MAK INFORMATION: Not listed

CARCINOGEN?: N STATUS: See below

CARCINOGEN LISTS:
IARC: Not listed
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

LD50 value: orl-rat LD50:>24 gm/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:>24 gm/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):
This chemical has no known mammalian reproductive toxicity.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)

California Prop 65: Not listed

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly when skin becomes wet.

** REMOVE CLOTHING:
Promptly remove non-impervious clothing that becomes wet.

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
OSHA (OIL MIST, MINERAL)
50 mg/M3: Any supplied-air respirator. / Any self-contained breathing apparatus. / Any air-purifying respirator with a high-efficiency particulate filter.
125 mg/M3: Any supplied-air respirator operated in a continuous flow mode. / Any powered air-purifying respirator with a high-efficiency particulate filter.
250 mg/M3: Any air-purifying full facepiece respirator with a high-efficiency particulate filter. / Any powered air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter. / Any supplied-air respirator with a tight-fitting facepiece operated in a continuous flow mode. / Any self-contained breathing apparatus with a full facepiece. / Any supplied-air respirator with a full facepiece.
2500 mg/M3: Any supplied-air respirator with a half-mask and operated in a pressure-demand or other positive pressure mode.
EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.:
Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
ESCAPE: Any air-purifying full facepiece respirator with a high-efficiency particulate filter. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID SOURCE: NIOSH
EYE: None given

SKIN: soap wash
INHALATION: fresh air
INGESTION: None given

---------- INITIAL INCIDENT RESPONSE ----------

No DOT Guide information for this compound.
DISCLAIMER: The data shown above on this chemical represents a best effort on the part of the compilers of the CHEMTOX database to obtain useful, accurate, and factual data. The use of these data shall be in accordance with the guidelines and limitations of the user's CHEMTOX license agreement.
The COMPILERS of the CHEMTOX database shall not be held liable for inaccuracies or omissions within this database, or in any of its printed or displayed output forms.

CHEMTOX DATA

---------- IDENTIFIERS ----------

CHEMTOX RECORD 323 LAST UPDATE OF THIS RECORD: 11/24/95

NAME: POLYCHLORINATED BIPHENYL(S) (PCBS)

SYNONYMS: AROCLOR; AROCLOR 1221; AROCLOR 1232; AROCLOR 1242; AROCLOR 1248; AROCLOR 1254; AROCLOR 1260; AROCLOR 1262; AROCLOR 1268; AROCLOR 2565; AROCLOR 4465; BIPHENYL, POLYCHLORO-; CHLOPHEN; CHLOREXTOL; CHLORINATED BIPHENYL; CHLORINATED DIPHENYL; CHLORINATED DIPHENYLENE; CHLORO BIPHENYL; CHLORO 1,1-BIPHENYL; CLOPHEN; DYKANOL; FENCLOR; INERTEEN; KANECHLOR; KANECHLOR 300; KANECHLOR 400; KANECHLOR 500; MONTAR; NOFLAMOL; PCB; PCBs; PHENOCHLOR; PHENOCLOR; POLYCHLORINATED BIPHENYL; POLYCHLOROBIPHENYL; PYRALENE; PYRANOL; SANTOTHERM; SANTOTHERM FR; SOVOL; THERMINOL FR-1; POLYCHLORINATED BIPHENYLS; PCB'S; 1,1'-BIPHENYL CHLORO DERIVS; 1,1'-BIPHENYL, CHLORO DERIVS.; AROCLOR - POLYCHLORINATED BIPHENYL; POLYCHLORINATED BIPHENYLS (PBB'S)

CAS: 1336-36-3 RTECS: TQ1350000

FORMULA: W99 MOL WT:

WLN:

CHEMICAL CLASS:Halogenated h-carbon

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION: light yellow oily liquid or white solid powder with a weak odor

BOILING POINT: NA

MELTING POINT: NA

FLASH POINT: 468.15 K 195 C 383 F

AUTO IGNITION: Not available

VAPOR PRESSURE:

UEL: Not applicable

LEL: Not applicable

VAPOR DENSITY: No data

SPECIFIC GRAVITY: 1.3 - 1.8@ 20C

DENSITY: 1.3 g/cc or 12.09 lb/gal

WATER SOLUBILITY:

INCOMPATIBILITIES:

REACTIVITY WITH WATER: No data on water reactivity

REACTIVITY WITH COMMON MATERIALS: No data

STABILITY DURING TRANSPORT: No Data

NEUTRALIZING AGENTS: No data

POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: None reported other than possible unburned vapors

ODOR DETECTED AT (ppm): Data not available
ODOR DESCRIPTION: Practically odorless Source:CHRIS
100 % ODOR DETECTION: No data

---------- REGULATIONS ----------

DOT hazard class: 9 CLASS 9
DOT guide: 31
Identification number: UN2315
DOT shipping name: Polychlorinated biphenyls
Packing group: II
Label(s) required: CLASS 9
Special provisions: 9
Packaging exceptions: 173.N81
Non bulk packaging: 173.155
Bulk packaging: 173.202
Quantity limitations-
Passenger air/rail: 240
Cargo aircraft only: 100 L
Vessel stowage: 220 L
Other stowage provisions:A

STCC NUMBER: 4961666

CLEAN WATER ACT Sect.307:Yes
CLEAN WATER ACT Sect.311:Yes
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 0.0005 mg/L (07/30/92)
Maximum Contaminant Level Goals (MCLG): 0 mg/L (07/30/92)
CLEAN AIR ACT: CAA '90 Listed
EPA WASTE NUMBER: None
CERCLA REF: Y
RQ DESIGNATION: X 1 pound (0.454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Chronic toxicity: carcinogen
Chronic toxicity: adverse effect to target organ after long period of exposure.
Chronic toxicity: reproductive toxin.
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 0.1 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Not given

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with

self-contained breathing apparatus.
FLAMMABILITY (RED) : (1) This material must be preheated before ignition can occur.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON ----------

California Assembly Bill 1803 Well Monitoring Chemicals.
California Assembly Bill 2588 Air Toxics "Hot Spots" Chemicals.
Canadian Domestic Substances List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 307 Priority Pollutants
Clean Water Act Section 311 Hazardous Chemicals List.
DOT Hazardous Materials Table. 49 CFR 172.101
EPA Carcinogen Assessment Group List
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Section 12(b) Export Rule Notification.
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
Massachusetts Substance List.
National Toxicology Program list of anticipated human carcinogens
New Jersey DEQ100 list for release reporting.
New Jersey Right To Know Substance List. (December 1987)
New Jersey Right to Know Substance List. Listed as a carcinogen.
New Jersey Right to Know Substance List. Listed as a teratogen.
POLYCHLORINATED BIPHENYL(S) (PCBS) [1336-36-3]
Pennsylvania Hazardous Substance List
SARA Section 110 Priority List of CERCLA Hazardous Substances
SARA Section 313 Toxic Chemicals List
Superfund/CERCLA RQ list. Table 302.4 in 54 FR 50968 (December 11, 1989)
Wisconsin Air Toxics Control Regulation NR-445 (December 1988)

---------- TOXICITY DATA ----------

SHORT TERM TOXICITY: Unknown

LONG TERM TOXICITY: unknown

TARGET ORGANS: skin, liver

SYMPTOMS: Acne from skin contact. Source: CHRIS

CONC IDLH: Nonegiven

NIOSH REL: Not given

ACGIH TLV: Not listed
ACGIH STEL: Not listed

OSHA PEL: Not in Table Z-1-A

MAK INFORMATION: Not listed

CARCINOGEN?: N STATUS: See below

CARCINOGEN LISTS:

IARC: Not listed
MAK: Not listed
NIOSH: Carcinogen defined by NIOSH with no further categorization.
NTP: Carcinogen defined by NTP as reasonably anticipated to be carcinogenic, with limited evidence in humans or sufficient evidence in experimental animals.
ACGIH: Not listed
OSHA: Not listed

LD50 value: No LD50 in RTECS 1992

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-mus LD50:1900 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)

orl-rat TDLo:400 mg/kg (6-15D preg) FAATDF 11,440,88
EFFECTS ON NEWBORN
Behavioral

orl-rat TDLo:420 mg/kg (21D post) FAATDF 11,440,88
EFFECTS ON NEWBORN
Behavioral

orl-rat TDLo:247 mg/kg (60D pre-22D post) FAATDF 15,457,90
EFFECTS ON NEWBORN
Behavioral

orl-rat TDLo:500 mg/kg (13D preg) GISAAA 56(9),44,91
EFFECTS ON NEWBORN

ipr-rat TDLo:700 mg/kg (14D pre) FAATDF 11,440,88
EFFECTS ON NEWBORN

Behavioral

orl-mam TDLo:325 mg/kg (30D pre/1-36D preg) AMBOCX 6,239,77
EFFECTS ON NEWBORN
Stillbirth
EFFECTS ON NEWBORN
Live birth index(# fetuses per liter)
EFFECTS ON NEWBORN
Viability index(# alive at day 4 per # born alive)

California Prop 65: No significant risk level .09 ugD (01/01/94)

---------- EPA's IRIS DATA SUMMARY ----------
Polychlorinated biphenyls (PCBs); CASRN 1336-36-3 (04/01/92)

_II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Polychlorinated biphenyls (PCBs)
CASRN -- 1336-36-3
Last Revised -- 01/01/90

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quantitative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

__II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

___II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- B2; probable human carcinogen

Basis -- hepatocellular carcinomas in three strains of rats and two strains of mice and inadequate yet suggestive evidence of excess risk of liver cancer in humans by ingestion and inhalation or dermal contact.

___II.A.2. HUMAN CARCINOGENICITY DATA

Inadequate. Although there are many studies, the data are inadequate due to confounding exposures or lack of exposure quantification. The first documentation of carcinogenicity associated with PCB exposure was reported at a New Jersey petrochemical plant involving 31 research and development employees and 41 refinery workers (Bahn et al., 1976, 1977). Although a statistically significant increase in malignant melanomas was reported, the two studies failed to report a quantified exposure level and to account for the presence of other potential or known carcinogens. In an expanded report of these studies, NIOSH (1977) concurred with the Bahn et al. (1976) findings. Brown and Jones (1981) reported a retrospective cohort mortality study on 2567 workers who had completed at least 3 months of employment at one or two capacitor manufacturing plants. Exposure levels were 24-393 mg/cu.m at plant A and 318-1260 mg/cu.m at plant B. No excess risk of cancer was observed. In a 7-year follow-up study, Brown (1987) reported a statistically significant excess risk of liver and biliary cancer, with four of the five liver cancers in female workers at plant B. A review of the pathology reports indicated that two of the liver tumors counted in the follow-up study were not primary liver tumors. When these tumors are excluded the elevation in incidence is not statistically significant. The results also may be confounded by population differences in alcohol consumption, dietary habits, and ethnic composition.

Bertazzi et al. (1987) conducted a mortality study of 544 male and 1556 female employees of a capacitor-making facility in Northern Italy. Aroclor 1254 and Pyralene 1476 were used in this plant until 1964. These were progressively replaced by Pyralenes 3010 and 3011 until 1970, after which lower chlorinated Pyralenes were used exclusively. In 1980 the use of PCBs was abandoned. Some employees also used trichloroethylene but, according to the authors, were presumed to be protected by efficient ventilation. Air samples were collected and analyzed for PCBs in 1954 and 1977 because of reports of chloracne in workers. Quantities of PCBs on workers' hands and workplace surfaces also were measured in 1977. In 18 samples, levels ranged from 0.2-159.0 ug/sq.m on workplace surfaces and 0.3-9.2 ug/sq.m on workers' hands.

The authors compared observed mortality with that expected between 1946 and 1982 based on national and local Italian mortality rates. With vital status ascertainment 99.5% complete, relatively few deaths were reported by 1982 [30 males (5.5%) and 34 females (2.2%)]. In cohort males, the number of deaths from malignant tumors was significantly higher than expected compared with local or national rates, as was the number of deaths from cancer of the GI tract (6 observed vs. 1.7 national expected and 2.2 local expected). Of the six GI cancer deaths, one was due to liver cancer and one to biliary tract cancer. Deaths from hematologic neoplasms in males were also higher than expected, but the excess was not statistically significant. Total cancer deaths in females were significantly elevated in comparison to local rates (12 observed vs. 5.3 expected). None of these were liver or biliary cancers. The number of deaths from hematologic neoplasms in females was higher than expected when compared with local rates (4 observed vs. 1.1 expected). This study is limited by several factors, particularly the small number of deaths that occurred by the cut-off period. The power of the study is insufficient to detect an elevated risk of site-specific cancer. In addition, the authors

stated, after an examination of the individual cases, that interpretation of the increase in GI tract cancer in males was limited, as it appeared likely that some of these individuals had only limited PCB exposure. Confounding factors may have included possible contamination of the PCBs by dibenzofurans and exposure of some of the workers to trichloroethylene, alkylbenzene, and epoxy resins.

Two occurrences of ingestion of PCB-contaminated rice oil have been reported: the Yusho incident of 1968 in Japan and the Yu-Cheng incident of 1979 in Taiwan. Amano et al. (1984) completed a 16-year retrospective cohort mortality study of 581 male and 505 female victims of the Yusho incident. A consistently high risk of liver cancer in females over the entire 16 years was observed; liver cancer in males was also significantly increased. Several serious limitations are evident in this study. There was a lack of information regarding job histories or the influence of alcoholism or smoking. The information concerning the diagnosis of liver cancer was obtained from the victims' families, and it is not clear whether this information was independently verified by health professionals. For some of the cancers described, the latency period is shorter than would be expected. Furthermore, the contaminated oils contained polychlorinated dibenzofurans and polychlorinated quinones as well as PCBs, and the study lacks data regarding exposure to the first two classes of compounds. There is strong evidence indicating that the health effects seen in Yusho victims were due to ingestion of polychlorinated dibenzofurans, rather than to PCBs themselves (reviewed in EPA, 1988). The results of the Amano et al. study can, therefore, be considered as no more than suggestive of carcinogenicity of PCBs.

___II.A.3. ANIMAL CARCINOGENICITY DATA

Sufficient. PCB mixtures assayed in the following studies were commercial preparations and may not be the same as mixtures of isomers found in the environment. Although animal feeding studies demonstrate the carcinogenicity of commercial PCB preparations, it is not known which of the PCB congeners in such preparations are responsible for these effects, or if decomposition products, contaminants or metabolites are involved in the toxic response. Early bioassays with rats (Kimura and Baba, 1973; Ito et al., 1974) were inadequate to assess carcinogenicity due to the small number of animals and short duration of exposure to PCB. A long-term bioassay of Aroclor 1260 reported by Kimbrough et al. (1975) produced hepatocellular carcinomas in female Sherman rats when 100 ppm was administered for 630 days to 200 animals. Hepatocellular carcinomas and neoplastic nodules were observed in 14 and 78%, respectively, of the dosed animals, compared with 0.58 and 0%, respectively, of the controls.

The NCI (1978) reported results for 24 male and 24 female Fischer 344 rats treated with Aroclor 1254 at 25, 50, or 100 ppm for 104 to 105 weeks. Although carcinomas of the gastrointestinal tract were observed among the treated animals only, the incidence was not statistically significantly elevated. An apparent dose-related incidence of hepatic nodular hyperplasia in both sexes as well as hepatocellular carcinomas among mid- to high-dose treated males was reported (4-12%, compared to 0% in controls).

Norback and Weltman (1985) fed 70 male and 70 female Sprague-Dawley rats a diet containing Aroclor 1260 in corn oil at 100 ppm for 16 months, followed by a 50 ppm diet for an additional 8 months, then a basal diet for 5 months. Control animals (63 rats/sex) received a diet containing corn oil for 18 months, then a basal diet alone for 5 months. Among animals that survived for at least 18 months, females exhibited a 91% incidence (43/47) of hepatocellular carcinoma. An additional 4% (2/47) had neoplastic nodules. In males corresponding incidences were 4% (2/46) for carcinoma and 11% (5/46) for neoplastic nodules. Concurrent liver morphology studies were carried out on tissue samples obtained by partial hepatectomies of three animals/group at eight time points. These studies showed the sequential progression of liver lesions to hepatocellular carcinomas.

Orally administered PCB resulted in increased incidences of hepatocellular carcinomas in two mouse strains. Ito et al. (1973) treated male dd mice (12/group) with Kanechlors 500, 400 and 300 each at dietary levels of 100, 250 or 500 ppm for 32 weeks. The group fed 500 ppm of Kanechlor 500 had a 41.7% incidence of hepatocellular carcinomas and a 58.3% incidence of nodular hyperplasia. Hepatocelluar carcinomas and nodular hyperplasia were not observed in mice fed 100 or 250 ppm of Kanechlor 500, nor among those fed Kanechlors 400 or 300 at any concentrations.

Schaeffer et al. (1984) fed male Wistar rats diets containing 100 ppm of the PCB mixtures Clophen A 30 (30% chlorine by weight) or Clophen A 60 (60% chlorine by weight) for 800 days. The PCB mixtures were reported to be free of furans. Clophen A 30 was administered to 152 rats, Clophen A 60 to 141 rats, and 139 rats received a standard diet. Mortality and histologic lesions were reported for animals necropsied during each 100-day interval for all three groups. Of the animals that survived the 800-day treatment period, 1/53 rats (2%) in the control group, 3/87 (3%) in the Clophen A 30 group and 52/85 (61%) in the Clophen A 60 group had developed hepatocellular carcinoma. The incidence in the Clophen A 60 group was significantly elevated in comparison to the control group. Neoplastic nodules were reported in 2/53 control, 35/87 Clophen A 30, and 34/85 Clophen A 60-treated animals. The incidence of nodules was significantly increased in both treatment groups in comparison to the control group. Neoplastic liver nodules and hepatocellular carcinomas appeared earlier and at higher incidence in the Clophen A 60 group relative to the Clophen A 30 group. The authors interpreted the results as indicative of a carcinogenic effect related to the degree of chlorination of the PCB mixture. The authors also suggested that these findings support those of others, including Ito et al. (1973) and Kimbrough et al. (1975), in which hepatocellular carcinomas were produced by more highly chlorinated mixtures.

Kimbrough and Linder (1974) dosed groups of 50 male BALB/cJ mice (a strain with a low spontaneous incidence of hepatoma) with Aroclor 1254 at 300 ppm in the diet for 11 months or 6 months, followed by a 5-month recovery period. Two groups of 50 mice were fed a control diet for 11 months. The incidence of hepatomas in survivors fed Aroclor 1254 for 11 months was 10/22. One hepatoma was observed in the 24 survivors fed Aroclor 1254 for 6 months.

II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

Most genotoxicity assays of PCBs have been negative. The majority of microbial assays of PCB mixtures and various congeners showed no evidence of mutagenic effects (Schoeny et al., 1979; Schoeny, 1982; Wyndham et al., 1976). Of various tests on the clastogenic effect of PCBs (Heddle and Bruce, 1977; Green et al., 1975), only Peakall et al. (1972) reported results indicative of a possible clastogenic action by PCBs in dove embryos.

Chlorinated dibenzofurans (CDFs), known contaminants of PCBs, and chlorinated dibenzodioxins (CDDs) are structurally related to and produce certain biologic effects similar to those of PCB congeners. While the CDDs are known to be carcinogenic, the carcinogenicity of CDFs is still under evaluation.

II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

II.B.1. SUMMARY OF RISK ESTIMATES

Oral Slope Factor -- 7.7/mg/kg/day

Drinking Water Unit Risk -- 2.2E-4/ug/L

Extrapolation Method -- Linearized multistage procedure, extra risk

Drinking Water Concentrations at Specified Risk Levels:

Risk Level	Concentration
E-4 (1 in 10,000)	5E-1 ug/L
E-5 (1 in 100,000)	5E-2 ug/L
E-6 (1 in 1,000,000)	5E-3 ug/L

II.B.2. DOSE-RESPONSE DATA (CARCINOGENICITY, ORAL EXPOSURE)

Tumor Type -- trabecular carcinoma/adenocarcinoma, neoplastic nodule
Test Animals -- rat/Sprague-Dawley, female
Route -- diet
Reference -- Norback and Weltman, 1985

Administered Dose (mg/kg)/day (TWA)	Human Equivalent Dose (mg/kg)/day	Tumor Incidence
0	0	1/49
3.45	0.59	45/47

___II.B.3. ADDITIONAL COMMENTS (CARCINOGENICITY, ORAL EXPOSURE)

Human equivalent dosage assumes a TWA daily dose of 3.45 mg/kg/day. This reflects the dosing schedule of 5 mg/kg/day (assuming the rat consumes an amount equal to 5% of its bw/day) for the first 16 months, 2.5 mg/kg/day for the next 8 months, and no dose for the last 5 months.

A slope factor of 3.9/mg/kg/day was based on data from the Kimbrough et al. (1975) study of female Sherman rats fed Aroclor 1260. The estimate based on the data of Norback and Weltman (1985) is preferred because Sprague-Dawley rats are known to have low incidence of spontaneous hepatocellular neoplasms. Moreover, the latter study spanned the natural life of the animal, and concurrent morphologic liver studies showed the sequential progression of liver lesions to hepatocellular carcinomas.

Although it is known that PCB congeners vary greatly as to their potency in producing biological effects, for purposes of this carcinogenicity assessment Aroclor 1260 is intended to be representative of all PCB mixtures. There is some evidence that mixtures containing more highly chlorinated biphenyls are more potent inducers of hepatocellular carcinoma in rats than mixtures containing less chlorine by weight (reviewed in Kimbrough, 1987 and Schaeffer et al., 1984).

The unit risk should not be used if the water concentration exceeds 50 ug/L, since above this concentration the slope factor may differ from that stated.

___II.B.4. DISCUSSION OF CONFIDENCE (CARCINOGENICITY, ORAL EXPOSURE)

The Norback and Weltman study used an adequate number of animals, observed for their normal lifespan. Only one non-zero test dose was used. A second risk estimate was also calculated based on the numbers of malignant tumors alone, as called for in the EPA's guidelines for carcinogen risk assessment. The slope factor thus derived is 5.7/mg/kg/day, which is 26% less than that derived using combined malignant tumors and neoplastic nodules. This risk estimate is supported by one based on data of Kimbrough et al. (1975).

PCB mixtures in drinking water may not be the same as the mixtures introduced or used for testing carcinogenicity in animals.

__II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

Not available.

__II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

___II.D.1. EPA DOCUMENTATION

U.S. EPA. 1988. Drinking Water Criteria Document for Polychlorinated Biphenyls (PCBs). Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Drinking Water, Washington, DC.

___II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The 1988 Drinking Water Criteria Document for PCBs has received OHEA review.

Agency Work Group Review: 04/22/87

Verification Date: 04/22/87

___II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

Charli Hiremath / ORD -- (202)260-5725/ FTS 260-5725

Debdas Mukerjee / ORD -- (513)569-7572/ FTS 684-7572
9-7572/ FTS 684-7572

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

FIRST AID SOURCE: CHRIS Manual 1991
SKIN: wash with soap and water.

FIRST AID SOURCE: DOT Emergency Response Guide 1990.
In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

---------- INITIAL INCIDENT RESPONSE ----------

FIRE EXTINGUISHMENT: Water, foam, dry chemical, or carbon dioxide. CHRIS91

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: Polychlorinated biphenyls
DOT ID NUMBER: UN2315

ERG93 GUIDE 31

POTENTIAL HAZARDS

*FIRE OR EXPLOSION
Some of these materials may burn, but none of them ignites readily.
Material may be transported hot.
*HEALTH HAZARDS
Contact may cause burns to skin and eyes.
Inhalation of asbestos dust may have a damaging effect on the lungs.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry.
Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC AT 1-800-424-9300. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
*Do not scatter spilled material with high-pressure water streams.
Dike fire control water for later disposal.
*SPILL OR LEAK
Stop leak if you can do it without risk.
Avoid inhalation of asbestos dust.
Small Dry Spills: With clean shovel place material into clean, dry container and cover loosely; move containers from spill area.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.
Cover powder spill with plastic sheet or tarp to minimize spreading.
*FIRST AID
In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

CHEMTOX DATA

---------- IDENTIFIERS ----------

CHEMTOX RECORD 84 LAST UPDATE OF THIS RECORD: 11/24/95

NAME:	CADMIUM		
SYNONYMS:	NONE		
CAS:	7440-43-9	RTECS:	EU9800000
FORMULA:	Cd	MOL WT:	112.40
WLN:	.CD		
CHEMICAL CLASS:	Metal		

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION: soft, blue-white, malleable, lustrous metal; grayish-white powder

BOILING POINT:	1040 K	766.8 C	1412.3 F
MELTING POINT:	593.9 K	320.7 C	609.3 F

FLASH POINT:	Not applicable
AUTO IGNITION:	Not applicable
VAPOR PRESSURE:	0 mm (APPROX)
UEL:	Not applicable
LEL:	Not applicable
VAPOR DENSITY:	No data
SPECIFIC GRAVITY:	8.64
DENSITY:	8.64
WATER SOLUBILITY:	insoluble
INCOMPATIBILITIES:	strong ox,elemental sulfur,selenium,tellurium
REACTIVITY WITH WATER:	No data on water reactivity
REACTIVITY WITH COMMON MATERIALS:	No data
STABILITY DURING TRANSPORT:	No Data
NEUTRALIZING AGENTS:	No data
POLYMERIZATION POSSIBILITIES:	No data
TOXIC FIRE GASES:	oxides of cadmium
ODOR DETECTED AT (ppm):	Unknown
ODOR DESCRIPTION:	No data
100 % ODOR DETECTION:	No data

---------- REGULATIONS ----------

DOT hazard class:	9 CLASS 9
DOT guide:	31
Identification number:	UN3077
DOT shipping name:	ENVIRONMENTALLY HAZARDOUS SUBSTANCES, SOLID, N.O.S. (CADMIUM)
Packing group:	III

Label(s) required: CLASS 9
Special provisions: 8, B54
Packaging exceptions: 173.155
Non bulk packaging: 173.213
Bulk packaging: 173.240
Quantity limitations-
Passenger air/rail: NONE
Cargo aircraft only: NONE
Vessel stowage: A
Other stowage provisions:

STCC NUMBER: Not listed

CLEAN WATER ACT Sect.307:Yes
CLEAN WATER ACT Sect.311:No
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 0.005 mg/L (07/30/92)
Maximum Contaminant Level Goals (MCLG): 0.005 mg/L (07/30/92)
CLEAN AIR ACT: CAA '90 By category
EPA WASTE NUMBER: D006
CERCLA REF: Y
RQ DESIGNATION: A 10 pounds (4.54 kg) CERCLA for pieces of solid met with diameter less than 100 micrometers (0.004 inches).
SARA TPQ VALUE: Not listed
SARA Sect. 312 categories:
Acute toxicity: adverse effect to target organs.
Chronic toxicity: carcinogen
Chronic toxicity: adverse effect to target organ after long period of exposure.
Chronic toxicity: mutagen.
Chronic toxicity: reproductive toxin.
Fire hazard: flammable.
Acute toxicity: Toxic. LD50 > 50 and <= 500 mg/kg (oral rat).
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 0.1 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Not given

---------- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON ----------

ACGIH TLV list "Threshold Limit Values for 1992-1993"
ATSDR Toxicology Profile available (NTIS**
CADMIUM [7440-43-9]
California Assembly Bill 2588 Air Toxics "Hot Spots" Chemicals.
California Assembly Bill 1807 Toxic Air Contaminants.

Canadian Domestic Substances List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 307 Priority Pollutants
EPA Carcinogen Assessment Group List
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
Massachusetts Substance List.
National Toxicology Program list of anticipated human carcinogens
New Jersey DEQ100 list for release reporting.
New Jersey Right To Know Substance List. (December 1987)
New Jersey Right to Know Substance List. Listed as a carcinogen.
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
Pennsylvania Hazardous Substance List
RCRA Hazardous Waste
RCRA Toxicity Characteristics (TC) list dated March 29, 1990
SARA Section 110 Priority List of CERCLA Hazardous Substances
SARA Section 313 Toxic Chemicals List
Suspected carcinogen (ACGIH). "Threshold Limit Values for 1992-1993"
Wisconsin Air Toxics Control Regulation NR-445 (December 1988)

---------- TOXICITY DATA ----------

SHORT TERM TOXICITY: Unknown

LONG TERM TOXICITY: unknown

TARGET ORGANS:	resp sys,lungs,kidneys,prostate,blood [prostatic and lung cancer]
SYMPTOMS:	INHALATION, INGESTION: PULM EDEMA, DYPSNEA, COUGH, TIGHT CHEST, SUBSTERNAL PAIN; HEADACHE, CHILLS, MUSCLE ACHE; NAUSEA, VOMITING, DIARRHEA, ANOSMIA, EMPHYSEMA; PROTEINURIA, MILD ANEMIA; [CARC] Source: NIOSHP
CONC IDLH:	9mg/M3 (asCd)
NIOSH REL:	Potential occupational carcinogen --LOWEST FEASIBLE (LOQ 0.01 mg/M3)
ACGIH TLV:	TLV = RESPIRABLE FRACTION 0.002mg/M3 as CADMIUM--TOTAL DUST 0.01 Mg/M3 Suspected human carcinogen (A2)
ACGIH STEL:	Not listed
OSHA PEL:	Final Rule Limits: TWA = 5 ug/M3

Consult 29CFR 1910.1027

MAK INFORMATION: Carcinogenic working material without MAK
In the Commission's view, an animal carcinogen.

CARCINOGEN?: Y STATUS: See below
REFERENCES:

ANIMAL POSITIVE IARC** 2,74,73
ANIMAL POSITIVE IARC** 11,39,76

CARCINOGEN LISTS:

IARC: Carcinogen as defined by IARC as carcinogenic to humans, with sufficient epidemiological evidence.
MAK: An animal carcinogen.
NIOSH: Carcinogen defined by NIOSH with no further categorization.
NTP: Carcinogen defined by NTP as reasonably anticipated to be carcinogenic, with limited evidence in humans or sufficient evidence in experimental animals.
ACGIH: Carcinogen defined by ACGIH TLV Committee as a suspected carcinogen, based on either limited epidemological evidence or demonstration of carcinogenicity in experimental animals.
OSHA: Cancer hazard

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)

ihl-man TCLo:88 ug/m3/8.6Y AEHLAU 28,147,74
KIDNEY,URETER,BLADDER
Proteinuria

ihl-hmn LCLo:39 mg/m3/20M AIHAAP 31,180,70
CARDIAC
Other changes
VASCULAR
Thrombosis distant from injection site(except brain,heart)
LUNGS, THORAX, OR RESPIRATION
Respiratory depression

LD50 value: orl-rat LD50:225 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:225 mg/kg
ihl-rat LC50:25 mg/m3/30M
ipr-rat LD50:4 mg/kg
scu-rat LD50:9 mg/kg

ivn-rat LD50:1800 ug/kg
unr-rat LD50:1140 mg/kg
orl-mus LD50:890 mg/kg
ihl-mus LCLo:170 mg/m3
ipr-mus LD50:5700 ug/kg
unr-mus LD50:890 mg/kg
orl-rbt LDLo:70 mg/kg
scu-rbt LDLo:6 mg/kg
ivn-rbt LDLo:5 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)
orl-rat TDLo:155 mg/kg (13W male/13W pre-3W preg) BECTA6 20,96,78
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)
EFFECTS ON NEWBORN
Behavioral

orl-rat TDLo:220 mg/kg (1-22D preg) TOLED5 11,233,82
EFFECTS ON EMBRYO OR FETUS
Other effects on embryo or fetus

orl-rat TDLo:21500 ug/kg (multigenerations) ENVRAL 22,466,80
EFFECTS ON FERTILITY
Pre-implantation mortility
EFFECTS ON NEWBORN
Germ cell effects(in offspring)

orl-rat TDLo:23 mg/kg (1-22D preg) PSEBAA 158,614,78
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Blood and lymphatic systems(including spleen and marrow)

ipr-rat TDLo:1124 ug/kg (1D male) TXAPA9 41,194,77
PATERNAL EFFECTS
Spermatogenisis

scu-rat TDLo:250 ug/kg (19D preg) APTOD9 19,A122,80
EFFECTS ON NEWBORN

ivn-rat TDLo:1250 ug/kg (14D preg) JJATDK 1,264,81
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Body wall
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Urogenital system

ivn-rat TDLo:1250 ug/kg (9D preg) JJATDK 1,264,81
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Central nervous system
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Eye,ear

ivn-rat TDLo:8 mg/kg (8-15D preg) JJATDK 1,264,81
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

orl-mus TDLo:448 mg/kg (multigenerations) AEHLAU 23,102,71
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
EFFECTS ON EMBRYO OR FETUS
Fetal death

orl-mus TDLo:1700 mg/kg (8-12D preg) TCMUD8 6,361,86
EFFECTS ON NEWBORN
Viability index(# alive at day 4 per # born alive)
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)

ipr-mus TDLo:1686 ug/kg (7D preg) TJADAB 28,39A,83
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Central nervous system

California Prop 65: No significant risk level .05 ugD (01/01/94)

---------- EPA's IRIS DATA SUMMARY ----------

Cadmium; CASRN 7440-43-9 (04/01/92)

_II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Cadmium
CASRN -- 7440-43-9
Last Revised -- 03/01/91

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quantitative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for

information on long-term toxic effects other than carcinogenicity.

II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- B1; probable human carcinogen

Basis -- Limited evidence from occupational epidemiologic studies of cadmium is consistent across investigators and study populations. There is sufficient evidence of carcinogenicity in rats and mice by inhalation and intramuscular and subcutaneous injection. Seven studies in rats and mice wherein cadmium salts (acetate, sulfate, chloride) were administered orally have shown no evidence of carcinogenic response.

II.A.2. HUMAN CARCINOGENICITY DATA

Limited. A 2-fold excess risk of lung cancer was observed in cadmium smelter workers. The cohort consisted of 602 white males who had been employed in production work a minimum of 6 months during the years 1940-1969. The population was followed to the end of 1978. Urine cadmium data available for 261 workers employed after 1960 suggested a highly exposed population. The authors were able to ascertain that the increased lung cancer risk was probably not due to the presence of arsenic or to smoking (Thun et al., 1985). An evaluation by the Carcinogen Assessment Group of these possible confounding factors has indicated that the assumptions and methods used in accounting for them may not be valid. As the SMRs observed were low and there is a lack of clear cut evidence of a causal relationship of the cadmium exposure only, this study is considered to supply only limited evidence of human carcinogenicity.

An excess lung cancer risk was also observed in three other studies which were, however, compromised by the presence of other carcinogens (arsenic, smoking) in the exposure or by a small population (Varner, 1983; Sorahan and Waterhouse, 1983; Armstrong and Kazantzis, 1983).

Four studies of workers exposed to cadmium dust or fumes provided evidence of a statistically significant positive association with prostate cancer (Kipling and Waterhouse, 1967; Lemen et al., 1976; Holden, 1980; Sorahan and Waterhouse, 1983), but the total number of cases was small in each study. The Thun et al. (1985) study is an update of an earlier study (Lemen et al., 1976) and does not show excess prostate cancer risk in these workers. Studies of human ingestion of cadmium are inadequate to assess carcinogenicity.

II.A.3. ANIMAL CARCINOGENICITY DATA

Exposure of Wistar rats to cadmium as cadmium chloride at concentrations of 12.5, 25 and 50 ug/cu.m for 18 months, with an additional 13-month obser-

vation period, resulted in significant increases in lung tumors (Takenaka et al., 1983). Intratracheal instillation of cadmium oxide did not produce lung tumors in Fischer 344 rats but rather mammary tumors in females and tumors at multiple sites in males (Sanders and Mahaffey, 1984). Injection site tumors and distant site tumors (for example, testicular) have been reported by a number of authors as a consequence of intramuscular or subcutaneous administration of cadmium metal and chloride, sulfate, oxide and sulfide compounds of cadmium to rats and mice (U.S. EPA, 1985). Seven studies in rats and mice where cadmium salts (acetate, sulfate, chloride) were administered orally have shown no evidence of a carcinogenic response.

___II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

Results of mutagenicity tests in bacteria and yeast have been inconclusive. Positive responses have been obtained in mutation assays in Chinese hamster cells (Dom and V79 lines) and in mouse lymphoma cells (Casto, 1976; Ochi and Ohsawa, 1983; Oberly et al., 1982).

Conflicting results have been obtained in assays of chromosomal aberrations in human lymphocytes treated in vitro or obtained from exposed workers. Cadmium treatment in vivo or in vitro appears to interfere with spindle formation and to result in aneuploidy in germ cells of mice and hamsters (Shimada et al., 1976; Watanabe et al., 1979; Gilliavod and Leonard, 1975).

__II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

Not available. There are no positive studies of orally ingested cadmium suitable for quantitation.

__II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

___II.C.1. SUMMARY OF RISK ESTIMATES

Inhalation Unit Risk -- 1.8E-3 per (ug/cu.m)

Extrapolation Method -- Two stage; only first affected by exposure; extra risk

Air Concentrations at Specified Risk Levels:

Risk Level	Concentration
E-4 (1 in 10,000)	6E-2 ug/cu.m

E-5 (1 in 100,000) 6E-3 ug/cu.m
E-6 (1 in 1,000,000) 6E-4 ug/cu.m

___II.C.2. DOSE-RESPONSE DATA FOR CARCINOGENICITY, INHALATION EXPOSURE

Tumor Type -- lung, trachea, bronchus cancer deaths
Test Animals -- human/white male
Route -- inhalation, exposure in the workplace
Reference -- Thun et al., 1985

Cumulative Exposure (mg/day/cu.m)	Median Observation	24 hour/ ug/cu.m Equivalent	No. of Expected Lung, Trachea and Bronchus Cancers Assuming No Cadmium Effect	Observed No. of Deaths (lung, trachea, bronchus cancers)
less than or equal to 584	280	168	3.77	2
585-2920	1210	727	4.61	7
greater than or equal to 2921	4200	2522	2.50	7

The 24-hour equivalent = median observation x 10E-3 x 8/24 x 1/365 x 240/365.

___II.C.3. ADDITIONAL COMMENTS (CARCINOGENICITY, INHALATION EXPOSURE)

The unit risk should not be used if the air concentration exceeds 6 ug/cu.m, since above this concentration the unit risk may not be appropriate.

___II.C.4. DISCUSSION OF CONFIDENCE (CARCINOGENICITY, INHALATION EXPOSURE)

The data were derived from a relatively large cohort. Effects of arsenic and smoking were accounted for in the quantitative analysis for cadmium effects.

An inhalation unit risk for cadmium based on the Takenaka et al. (1983) analysis is 9.2E-2 per (ug/cu.m). While this estimate is higher than that derived from human data [1.8E-3 per (ug/cu.m)] and thus more conservative, it was felt that the use of available human data was more reliable because of species variations in response and the type of exposure (cadmium salt vs. cadmium fume and cadmium oxide).

II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

II.D.1. EPA DOCUMENTATION

U.S. EPA. 1985. Updated Mutagenicity and Carcinogenicity Assessment of Cadmium: Addendum to the Health Assessment Document for Cadmium (May 1981, EPA 600/B-Bl-023). EPA 600/B-83-025F.

II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The Addendum to the Cadmium Health Assessment has received both Agency and external review.

Agency Work Group Review: 11/12/86

Verification Date: 11/12/86

II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

William E. Pepelko / ORD -- (202)260-5904 / FTS 260-5904

David Bayliss / ORD -- (202)260-5726 / FTS 260-5726

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR EYE PROTECTION TO PREVENT:

** EXPOSED PERSONNEL SHOULD WASH:
At the end of each work shift when there was a reasonable probability of co

** WORK CLOTHING SHOULD BE CHANGED DAILY:
If there is any possibility that the clothing may be contaminated.

** THE FOLLOWING EQUIPMENT SHOULD BE MADE AVAILABLE:
Eyewash.

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
OSHA (CADMIUM)
50 ug/M3 or less: Half mask, air purifying respirator equipped with a HEPA filter.
125 ug/M3 or less: A powered air purifying respirator (PAPR) with a loose-fitting hood or helmet equipped with a HEPA filter, or a supplied air respirator with a loose-fitting hood or helmet facepiece operated in the continuous flow mode.
250 ug/M3 or less: A full facepiece air-purifying respirator equipped with a HEPA filter, or a powered air-purifying respiratorwith a tight-fitting half-mask equipped with a HEPA filter, or a supplied-air respirator with a tight-fitting half mask operated in the continuous flow mode.
1250 ug/M3 or less: A powered air-purifying respirator with a tight fitting full facepiece equipped with a HEPA filter, or a supplied air respirator with a tight-fitting full facepiece operated in the continuous flow mode.
5000 ug/M3 or less: A supplied air respirator with half-mask or full facepiece operated in the pressure demand or other positive pressure mode.
Greater than 5000 ug/M3 or unknown concentration: A self-contained breathing apparatus with a full facepiece operated in the pressure demand or other positive pressure mode, or a supplied-air respirator with a full facepiece operated in the pressure demand or other positive pressure mode and equipped with an auxiliary escape type self-contained breathing apparatus operated in the pressure demand mode.
EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.:
Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode.

FIRST AID SOURCE: NIOSH
EYE: irr immed
SKIN: soap wash
INHALATION: art resp
INGESTION: water, vomit

FIRST AID SOURCE: DOT Emergency Response Guide 1990.
In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

---------- INITIAL INCIDENT RESPONSE ----------

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: ENVIRONMENTALLY HAZARDOUS SUBSTANCES, SOLID, N.O.S. (CADMIUM
DOT ID NUMBER: UN3077

*FIRE OR EXPLOSION
Some of these materials may burn, but none of them ignites readily.
Material may be transported hot.
*HEALTH HAZARDS
Contact may cause burns to skin and eyes.
Inhalation of asbestos dust may have a damaging effect on the lungs.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry.
Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC AT 1-800-424-9300. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
*Do not scatter spilled material with high-pressure water streams.
Dike fire control water for later disposal.
*SPILL OR LEAK
Stop leak if you can do it without risk.
Avoid inhalation of asbestos dust.
Small Dry Spills: With clean shovel place material into clean, dry container and cover loosely; move containers from spill area.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.
Cover powder spill with plastic sheet or tarp to minimize spreading.
*FIRST AID
In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

CHEMTOX DATA

---------- IDENTIFIERS ----------

CHEMTOX RECORD 116 LAST UPDATE OF THIS RECORD: 11/24/95

NAME:	CHROMIUM		
SYNONYMS:			
CAS:	7440-47-3	RTECS:	GB4200000
FORMULA:	Cr	MOL WT:	51.996
WLN:	CR		
CHEMICAL CLASS:	Metal		

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION:	steel-gray metal or silver metal powder.(nydh); blue-white to steel gray, lustrous, brittle, hard, odorless solid (niosh)		
BOILING POINT:	2915 K	2641.8 C	4787.3 F
MELTING POINT:	2173 K	1899.8 C	3451.7 F
FLASH POINT:	Not applicable		
AUTO IGNITION:	Not applicable		
VAPOR PRESSURE:	0 mm (APPROX)		
UEL:	Not applicable		
LEL:	Not applicable		
VAPOR DENSITY:	No data		
SPECIFIC GRAVITY:	7.14		
DENSITY:	7.200		
WATER SOLUBILITY:	INSOLUBLE		
INCOMPATIBILITIES:	strong oxidizers (such as hydrogen peroxide), alkalis		
REACTIVITY WITH WATER:	No data on water reactivity		
REACTIVITY WITH COMMON MATERIALS:	No data		
STABILITY DURING TRANSPORT:	No Data		
NEUTRALIZING AGENTS:	No data		
POLYMERIZATION POSSIBILITIES:	No data		
TOXIC FIRE GASES:	None reported other than possible unburned vapors		
ODOR DETECTED AT (ppm):	Unknown		
ODOR DESCRIPTION:	NONE Source:NYDH		
100 % ODOR DETECTION:	No data		

---------- REGULATIONS ----------

DOT hazard class:	9 CLASS 9
DOT guide:	31
Identification number:	UN3077
DOT shipping name:	ENVIRONMENTALLY HAZARDOUS SUBSTANCES, SOLID, N.O.S. (CHROMIUM)

Packing group: III
Label(s) required: CLASS 9
Special provisions: 8, B54
Packaging exceptions: 173.155
Non bulk packaging: 173.213
Bulk packaging: 173.240
Quantity limitations-
Passenger air/rail: NONE
Cargo aircraft only: NONE
Vessel stowage: A
Other stowage provisions:

STCC NUMBER: Not listed

CLEAN WATER ACT Sect.307:Yes
CLEAN WATER ACT Sect.311:No
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 0.1 mg/L (07/30/92)
Maximum Contaminant Level Goals (MCLG): 0.1 mg/L (07/30/92)
CLEAN AIR ACT: CAA '90 By category
EPA WASTE NUMBER: D007
CERCLA REF: Y
RQ DESIGNATION: D 5000 pounds (2270 kg) CERCLA for pieces of solid metal with diameter less than 100 micrometers (0.004 inches).
SARA TPQ VALUE: Not listed
SARA Sect. 312 categories:
Chronic toxicity: carcinogen
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 1.0 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Not given

---------- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON ----------

ACGIH TLV list "Threshold Limit Values for 1992-1993"
ATSDR Toxicology Profile available (NTIS** PB/89/236665/AS)
CHROMIUM [7440-47-3]
California Assembly Bill 1807 Toxic Air Contaminants.
Canadian Domestic Substances List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 307 Priority Pollutants
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990

EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
Massachusetts Substance List.
National Toxicology Program (NTP) list of human carcinogens
New Jersey DEQ100 list for release reporting.
New Jersey Right To Know Substance List. (December 1987)
New Jersey Right to Know Substance List. Listed as a carcinogen.
New Jersey Right to Know Substance List. Listed as a mutagen.
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
Pennsylvania Hazardous Substance List
RCRA Hazardous Waste
RCRA Toxicity Characteristics (TC) list dated March 29, 1990
SARA Section 110 Priority List of CERCLA Hazardous Substances
SARA Section 313 Toxic Chemicals List
Wisconsin Air Toxics Control Regulation NR-445 (December 1988)

---------- TOXICITY DATA ----------

SHORT TERM TOXICITY: INHALATION: dust may cause irritation of the nose, throat and lungs. SKIN: dust may cause irritation. Eyes: dust may cause irritation. INGESTION: dust may cause irritation of the mouth and throat.(NYDH)

LONG TERM TOXICITY: no information found on exposure to chromium metal. see specific chromium compounds.(NYDH)

TARGET ORGANS: eyes, skin, resp sys

SYMPTOMS: INHALATION, INGESTION, CONTACT: IRRIT EYES, SKIN; HISTOLOGIC FIBROSIS OF LUNGS Source: NIOSHP

CONC IDLH: 250mg/m3(ASCr)

NIOSH REL:

ACGIH TLV: TLV = 0.5mg/M3 as CHROMIUM A4
ACGIH STEL: Not listed

OSHA PEL: Transitional Limits:
PEL = 1mg/M3
Final Rule Limits:
TWA = 1 mg/M3

MAK INFORMATION: Not listed

CARCINOGEN?: N STATUS: See below
REFERENCES:
ANIMAL SUSPECTED IARC** 2,100,73

ANIMAL INDEFINITE IARC** 23,205,80

CARCINOGEN LISTS:

IARC: Not classified as to human carcinogenicity or probably not carcinogenic to humans.
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not classifiable as a Human Carcinogen due to inadequate data.
OSHA: Not listed

LD50 value: No LD50 in RTECS 1992

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

unr-rat LD50:27500 ug/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):
This chemical has no known mammalian reproductive toxicity.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)

California Prop 65: Not listed

---------- EPA's IRIS DATA SUMMARY ----------
Chromium(VI); CASRN 7440-47-3 (04/01/92)

_II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Chromium(VI)
CASRN -- 7440-47-3
Last Revised -- 03/01/91

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quantitative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive

the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

__II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

___II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- A; human carcinogen

Basis -- Results of occupational epidemiologic studies of chromium-exposed workers are consistent across investigators and study populations. Dose-response relationships have been established for chromium exposure and lung cancer. Chromium-exposed workers are exposed to both chromium III and chromium VI compounds. Because only chromium VI has been found to be carcinogenic in animal studies, however, it was concluded that only chromium VI should be classified as a human carcinogen.

___II.A.2. HUMAN CARCINOGENICITY DATA

Sufficient. Epidemiologic studies of chromate production facilities in the United States (Machle and Gregorius, 1948; Brinton et al., 1952; Mancuso and Hueper, 1951, Mancuso, 1975; Baetjer, 1950; Taylor, 1966; Enterline, 1974; Hayes et al., 1979; Hill and Ferguson, 1979), Great Britain (Bidstrup, 1951; Bidstrup and Case, 1956; Alderson et al., 1981), Japan (Watanabe and Fukuchi, 1975; Ohsaki et al., 1978; Sano and Mitohara, 1978; Satoh et al., 1981) and West Germany (Korallus et al., 1982; Bittersohl, 1971) have established an association between chromium (Cr) exposure and lung cancer. Most of these studies did not attempt to determine whether Cr III or Cr VI compounds were the etiologic agents.

Three studies of the chrome pigment industry, one in Norway (Langard and Norseth, 1975), one in England (Davies, 1978, 1979), and the third in the Netherlands and Germany (Frentzel-Beyme, 1983) also found an association between occupational chromium exposure (predominantly to Cr VI) and lung cancer.

Results of two studies of the chromium plating industry (Royle, 1975; Silverstein et al., 1981) were inconclusive, while the findings of a Japanese study of chrome platers were negative (Okubo and Tsuchiya, 1979). The results of studies of ferrochromium workers (Pokrovskaya and Shabynina, 1973; Langard et al., 1980; Axelsson et al., 1980) were inconclusive as to lung cancer risk.

___II.A.3. ANIMAL CARCINOGENICITY DATA

Sufficient. Hexavalent chromium compounds were carcinogenic in animal assays producing the following tumor types: intramuscular injection site tumors in Fischer 344 and Bethesda Black rats and in C57BL mice (Furst et

al., 1976; Maltoni, 1974, 1976; Payne, 1960; Heuper and Payne, 1959); intraplural implant site tumors for various chromium VI compounds in Sprague-Dawley and Bethesda Black rats (Payne, 1960; Heuper 1961; Heuper and Payne, 1962); intrabronchial implantation site tumors for various Cr VI compounds in Wistar rats (Levy and Martin, 1983; Laskin et al., 1970; Levy as quoted in NIOSH, 1975); and subcutaneous injection site sarcomas in Sprague-Dawley rats (Maltoni, 1974, 1976).

___II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

A large number of chromium compounds have been assayed in in vitro genetic toxicology assays. In general, hexavalent chromium is mutagenic in bacterial assays whereas trivalent chromium is not (Lofroth, 1978; Petrellie and Flora, 1977, 1978). Likewise Cr VI but not Cr III was mutagenic in yeasts (Bonatti et al., 1976) and in V79 cells (Newbold et al., 1979). Chromium III and VI compounds decrease the fidelity of DNA synthesis in vitro (Loeb et al., 1977), while Cr VI compounds inhibit replicative DNA synthesis in mammalian cells (Levis et al., 1978) and produce unscheduled DNA synthesis, presumably repair synthesis, as a consequence of DNA damage (Raffetto, 1977). Chromate has been shown to transform both primary cells and cell lines (Fradkin et al., 1975; Tsuda and Kato, 1977; Casto et al., 1979). Chromosomal effects produced by treatment with chromium compounds have been reported by a number of authors; for example, both Cr VI and Cr III salts were clastogenic for cultured human leukocytes (Nakamuro et al., 1978).

There are no long-term studies of ingested Cr VI. There appears to be significant in vivo conversion of Cr VI to Cr III and III to VI; Cr III is an essential trace element.

__II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

Not available.

__II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

___II.C.1. SUMMARY OF RISK ESTIMATES

Inhalation Unit Risk -- 1.2E-2 per (ug/cu.m)

Extrapolation Method -- Multistage, extra risk

Air Concentrations at Specified Risk Levels:

Risk Level	Concentration
E-4 (1 in 10,000)	8E-3 ug/cu.m
E-5 (1 in 100,000)	8E-4 ug/cu.m
E-6 (1 in 1,000,000)	8E-5 ug/cu.m

___II.C.2. DOSE-RESPONSE DATA FOR CARCINOGENICITY, INHALATION EXPOSURE

Species/Strain Tumor Type	Dose	Tumor Incidence		Reference
human	Route: Occupational exposure (inhalation)			
Age (years)	Midrange (ug/cu.m)	Deaths from Lung Cancer	Person Years	
50	5.66	3	1345	Mancuso,
	25.27	6	931	1975
	46.83	6	299	
60	4.68	4	1063	
	20.79	5	712	
	39.08	5	211	
70	4.41	2	401	
	21.29	4	345	

___II.C.3. ADDITIONAL COMMENTS (CARCINOGENICITY, INHALATION EXPOSURE)

The cancer mortality in Mancuso (1975) was assumed to be due to Cr VI, which was further assumed to be no less than one-seventh of total chromium. It was also assumed that the smoking habits of chromate workers were similar to those of the U.S. white male population. The unit risks of Langard et al. (1980), Axelsson et al. (1980), and Pokrovskaya and Shabynina (1973) are 1.3E-1, 3.5E-2 and 9.2E-2 per (ug/cu.m), respectively.

Hexavalent chromium compounds have not produced lung tumors in animals by inhalation. Trivalent chromium compounds have not been reported as carcinogenic by any route of administration.

The unit risk should not be used if the air concentration exceeds 8E-1 ug/cu.m, since above this concentration the unit risk may not be appropriate.

___II.C.4. DISCUSSION OF CONFIDENCE (CARCINOGENICITY, INHALATION EXPOSURE)

Results of studies of chromium exposure are consistent across investigators and countries. A dose-relationship for lung tumors has been established. The assumption that the ratio of Cr III to Cr VI is 6:1 may lead to a 7-fold underestimation of risk. The use of 1949 hygiene data, which may underestimate worker exposure, may result in an overestimation of risk. Further overestimation of risk may be due to the implicit assumption that the smoking habits of chromate workers were similar to those of the general white male population, since it is generally accepted that the proportion of smokers is higher for industrial workers than for the general population.

__II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

___II.D.1. EPA DOCUMENTATION

Mancuso, T.F. 1975. International Conference on Heavy Metals in the Environment. Toronto, Ontario, Canada.

U.S. EPA. 1984. Health Assessment Document for Chromium. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH. EPA 600/8-83-014F.

___II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The quantification of cancer risk in the 1984 Health Assessment Document has received peer review in public sessions of the Environmental Health Committee of the U.S. EPA's Science Advisory Board.

Agency Work Group Review: 06/26/86

Verification Date: 06/26/86

___II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

Herman J. Gibb / ORD -- (202)260-5898 / FTS 260-5898

Chao W. Chen / ORD -- (202)260-5719 / FTS 260-5719

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly when skin becomes contaminated.

** REMOVE CLOTHING:
Promptly remove non-impervious clothing that becomes contaminated.

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
OSHA (CHROMIUM)
2.5 mg/M3: Any dust and mist respirator except single-use respirators. * Substance reported to cause eye irritation or damage may require eye protection.
5 mg/M3: Any dust and mist respirator except single-use and quarter-mask respirators. * Substance reported to cause eye irritation or damage may require eye protection. / Any supplied-air respirator. * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus. * Substance reported to cause eye irritation or damage may require eye protection.
12.5 mg/M3: Any powered air-purifying respirator with a dust and mist filter. * Substance reported to cause eye irritation or damage may require eye protection. / Any supplied-air respirator operated in a continuous flow mode. * Substance reported to cause eye irritation or damage may require eye protection.
25 mg/M3: Any air-purifying full facepiece respirator with a high-efficiency particulate filter. / Any powered air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter. * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus with a full facepiece. / Any supplied-air respirator with a full facepiece.
250 mg/M3: Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode.
EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.: Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
ESCAPE: Any air-purifying full facepiece respirator with a high-efficiency particulate filter. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID SOURCE: NIOSH
EYE: irr immed
SKIN: soap wash
INHALATION: art resp
INGESTION: water, vomit

FIRST AID SOURCE: DOT Emergency Response Guide 1990.
In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

---------- INITIAL INCIDENT RESPONSE ----------

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: ENVIRONMENTALLY HAZARDOUS SUBSTANCES, SOLID, N.O.S. (CHROMIU
DOT ID NUMBER: UN3077

ERG93 GUIDE 31

POTENTIAL HAZARDS

*FIRE OR EXPLOSION
Some of these materials may burn, but none of them ignites readily.
Material may be transported hot.
*HEALTH HAZARDS
Contact may cause burns to skin and eyes.
Inhalation of asbestos dust may have a damaging effect on the lungs.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry.
Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC AT 1-800-424-9300. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
*Do not scatter spilled material with high-pressure water streams.
Dike fire control water for later disposal.
*SPILL OR LEAK
Stop leak if you can do it without risk.
Avoid inhalation of asbestos dust.
Small Dry Spills: With clean shovel place material into clean, dry container and cover loosely; move containers from spill area.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.
Cover powder spill with plastic sheet or tarp to minimize spreading.
*FIRST AID
In case of contact with material, immediately flush eyes with running

water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

CHEMTOX DATA

IDENTIFIERS

CHEMTOX RECORD 247 LAST UPDATE OF THIS RECORD: 11/24/95

NAME:	LEAD		
SYNONYMS:	C.I. PIGMENT METAL 4; C.I. 77575; KS-4; LEAD FLAKE; LEAD S2; OLOW (Polish); SI; SO		
CAS:	7439-92-1	RTECS:	OF7525000
FORMULA:	Pb	MOL WT:	207.19
WLN:	PB		
CHEMICAL CLASS:	Metal		

See other identifiers listed below under Regulations.

PROPERTIES

PHYSICAL DESCRIPTION: bluish-grey, soft metal; heavy ductile, soft, gray solid

BOILING POINT:	2013 K	1739.8 C	3163.7 F
MELTING POINT:	600.6 K	327.4 C	621.4 F
FLASH POINT:	Not available		
AUTO IGNITION:	Not available		
VAPOR PRESSURE:	1mm @ 973 C		
UEL:	~		
LEL:	~		
VAPOR DENSITY:	No data		
SPECIFIC GRAVITY:	11.34		
DENSITY:	11.34 g/mL @ 20 C		
WATER SOLUBILITY:	INSOLUBLE; DISSOLVES SLOWLY IN WATER CONTAINING A WEAK ACID		
INCOMPATIBILITIES:	strong ox, hydrogen peroxide, active metals, sodium, potassium, chlorine trifluoride, hydrogen peroxide, zirconium, disdium acetylide, oxidants, acids		
REACTIVITY WITH WATER:	No data on water reactivity		
REACTIVITY WITH COMMON MATERIALS:	RELATIVELY IMPENETRABLE TO RADIATION		
STABILITY DURING TRANSPORT:	No Data		
NEUTRALIZING AGENTS:	No data		
POLYMERIZATION POSSIBILITIES:	No data		
TOXIC FIRE GASES:	WHEN HEATED EMITS HIGHLY TOXIC FUMES; CAN REACT VIGOROUSLY WITH OXIDIZING MATERIALS		
ODOR DETECTED AT (ppm):	Unknown		
ODOR DESCRIPTION:	No data		
100 % ODOR DETECTION:	No data		

REGULATIONS

National Primary Ambient Air Quality Standards
1.5 ug/M3 maximum arithmetic mean averaged over a calendar year
National Secondary Ambient Air Quality Standards
same as primary standard

DOT hazard class:	6.1 POISON
DOT guide:	53
Identification number:	UN2291
DOT shipping name:	LEAD COMPOUNDS, SOLUBLE, N.O.S.
Packing group:	III
Label(s) required:	KEEP AWAY FROM FOOD
Special provisions:	
Packaging exceptions:	173.153
Non bulk packaging:	173.213
Bulk packaging:	173.240
Quantity limitations-	
Passenger air/rail:	100 KG
Cargo aircraft only:	200 KG
Vessel stowage:	A
Other stowage provisions:	

STCC NUMBER: Not listed

CLEAN WATER ACT Sect.307:Yes
CLEAN WATER ACT Sect.311:No
National Primary Drinking Water Regulations
  Maximum Contaminant Levels (MCL): Treatment technique (12/07/92)
  Maximum Contaminant Level Goals (MCLG): 0 mg/L (12/07/92)
CLEAN AIR ACT: CAA '90 Listed and CAA '77 Sect 109
EPA WASTE NUMBER: D008
CERCLA REF: Y
RQ DESIGNATION: A 10 pounds (4.54 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Chronic toxicity: carcinogen
Chronic toxicity: adverse effect to target organ after long period of exposure.
Chronic toxicity: mutagen.
Chronic toxicity: reproductive toxin.

LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 0.1 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: ORM-B
Mailability: Domestic service and air transportation; shipper's declaration
Max per parcel: 25 LBS; 5 LBS

---------- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON ----------

ACGIH TLV list "Threshold Limit Values for 1992-1993"
California Assembly Bill 2588 Air Toxics "Hot Spots" Chemicals.
California Assembly Bill 1807 Toxic Air Contaminants.
California Proposition 65 Developmental Toxin List
California Proposition 65 Female Reproductive Toxin List
California Proposition 65 Male Reproductive Toxin List
Canadian Domestic Substances List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
Clean Air Act Section 109 National Ambient Air Quality Standards List
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 307 Priority Pollutants
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
LEAD [7439-92-1]
Massachusetts Substance List.
New Jersey DEQ100 list for release reporting.
New Jersey Right To Know Substance List. (December 1987)
New Jersey Right to Know Substance List. Listed as a teratogen.
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
OSHA Specifically regulated substance. See 29 CFR 1910.1025
Pennsylvania Hazardous Substance List
RCRA Hazardous Waste
RCRA Toxicity Characteristics (TC) list dated March 29, 1990
SARA Section 313 Toxic Chemicals List

---------- TOXICITY DATA ----------

SHORT TERM TOXICITY: LASSITUDE, INSOMNIA, PALLOR, EYE GROUNDS, ANOREXIA, LOW-WEIGHT, MALNUTRITION, CONSTIPATION, ABDOMINAL PAIN, COLIC; HYPOTENSE, ANEMIA; GINGIVAL LEAD LINE; TREMBLING PARALYSIS WRIST. ** Source: 2

LONG TERM TOXICITY: unknown

TARGET ORGANS: gi,CNS,kidneys,blood,gingival tissue,eyes

SYMPTOMS: INHALATION, INGESTION, CONTACT: ENCEPHALOPATHY; KIDNEY DISEASE; IRRIT EYES; HYPOTENSION, WEAKNESS, FACIAL PALLOR, LASSITUDE, INSOMNIA, PAL, EYE GROUNDS, ANOREXIA, WEIGHT LOSS, MALNUTRITION, CONSTIPATION, ABDOM PAIN, COLIC; HYPOTENSION, ANEMIA, GINGIVAL LEAD LINE; TREMORS, PARALYSIS WRIST, ANKLES. METALLIC TASTE, INCREASED SALIVATION, PYORRHEA (FLOW OF MUCOUS). NEUROMUSCULAR: NUMBNESS AND TINGLING

OF EXTREMITIES WITH SENSORY DISTRUBANCE, EXTENSOR WEAKNESS OF WRISTS AND ANKLES, LOSS OF MUSCLE TONE, TREMOR INCREASED DEEP-TENDON REFLEXES, MUSCULAR CRAMPS AND ACHING, MUSCULAR ATROPHY. CNS: VISUAL DISTURBANCES, HEADACHE, NERVOUSNESS OF DEPRESSION, INSOMNIA, MENTAL CONFUSION, DELIRIUM. Source: NIOSHP, THIC

CONC IDLH: 100mg/m3(ASPb)

NIOSH REL: <0.1 mg/M3 Air level to be maintained so that worker blood level remains <0.06 mg/100 g of whole blood

ACGIH TLV: TLV = 0.15mg/M3 as LEAD
ACGIH STEL: Not listed

OSHA PEL: Final Rule Limits:
TWA = See 29 CFR 1910.1025 and 1926.62
50 ug/M3

MAK INFORMATION: 0.1 calculated as total dust mG/M3
Substance with systemic effects, onset of effect over 2 hours: Peak = 10xMAK for 30 minutes, once per shift of 8 hours.
Risk of damage to the developing embryo or fetus must be considered probable. Damage cannot be excluded even when the MAK values are adhered to.

CARCINOGEN?: Y STATUS: See below

CARCINOGEN LISTS:

IARC: Carcinogen defined by IARC to be possibly carcinogenic to humans, but having (usually) no human evidence.
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Animal carcinogen. The chemical is carcinogenic in experimental animals at a relatively high dose, by routes or administration, at sites, or histological types, or by mechanisms that are not considered relevant to worker exposure.
OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)
orl-wmn TDLo:450 mg/kg/6Y JAMAAP 237,2627,77
PERIPHERAL NERVE AND SENSATION

Flaccid paralysis without anesthesia
BEHAVIORAL
Hallucinations, distorted perceptions
BEHAVIORAL
Muscle weakness

LD50 value: No LD50 in RTECS 1992

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

ipr-rat LDLo:1 gm/kg
orl-pgn LDLo:160 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)
orl-rat TDLo:790 mg/kg (multigenerations) AEHLAU 23,102,71
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
EFFECTS ON EMBRYO OR FETUS
Fetal death

orl-rat TDLo:1140 mg/kg (14D pre-21D post) PHMCAA 20,201,78
EFFECTS ON NEWBORN
Behavioral

orl-rat TDLo:520 mg/kg (7-22D preg/10D post) FEPRA7 37,394,78
EFFECTS ON NEWBORN

orl-rat TDLo:1100 mg/kg (1-22D preg) FEPRA7 37,895,78
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Blood and lymphatic systems(including spleen and marrow)
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)

ihl-rat TCLo:10 mg/m3/24H (1-21D preg) ZHPMAT 165,294,77
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Blood and lymphatic systems(including spleen and marrow)

ihl-rat TCLo:3 mg/m3/24H (1-21D preg) ZHPMAT 165,294,77

EFFECTS ON NEWBORN

orl-mus TDLo:1120 mg/kg (multigenerations) AEHLAU 23,102,71
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
EFFECTS ON EMBRYO OR FETUS
Fetal death

orl-mus TDLo:6300 mg/kg (1-21D preg) EXPEAM 31,1312,75
EFFECTS ON FERTILITY
Female fertility index
EFFECTS ON FERTILITY
Pre-implantation mortility

orl-mus TDLo:300 mg/kg (1-2D preg) TXCYAC 6,129,76
EFFECTS ON FERTILITY
Other measures of fertility

orl-mus TDLo:4800 mg/kg (1-16D preg) BECTA6 18,271,77
EFFECTS ON EMBRYO OR FETUS
Cytological changes(including somatic cell genetic material)

orl-dom TDLo:662 mg/kg (1-21W preg) TXAPA9 25,466,73
EFFECTS ON NEWBORN
Behavioral

California Prop 65: Developmental toxin (02/27/87)
Female reproductive toxin (02/27/87)
Male reproductive toxin (02/27/87)
Acceptable intake level-inhalation .5 ugD (01/01/94)
Carcinogen (10/01/92)

---------- EPA's IRIS DATA SUMMARY ----------
Lead and compounds (inorganic); CASRN 7439-92-1 (04/01/92)

_II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Lead and compounds (inorganic)
CASRN -- 7439-92-1
Last Revised -- 05/01/91

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quantitative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L

drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

__II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

___II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- B2; probable human carcinogen

Basis -- Sufficient animal evidence. Ten rat bioassays and one mouse assay have shown statistically significant increases in renal tumors with dietary and subcutaneous exposure to several soluble lead salts. Animal assays provide reproducible results in several laboratories, in multiple rat strains with some evidence of multiple tumor sites. Short term studies show that lead affects gene expression. Human evidence is inadequate.

___II.A.2. HUMAN CARCINOGENICITY DATA

Inadequate. There are four epidemiologic studies of occupational cohorts exposed to lead and lead compounds. Two studies (Dingwall-Fordyce and Lane, 1963; Nelson et al., 1982) did not find any association between exposure and cancer mortality. Selevan et al. (1985), in their retrospective cohort mortality study of primary lead smelter workers, found a slight decrease in the total cancer mortality (SMR=95). Apparent excesses were observed for respiratory cancer (SMR=111, obs=41, $p>0.05$) and kidney cancer (SMR=204, obs=6, $p>0.05$). Cooper and Gaffey (1975) and Cooper (1985 update) performed a cohort mortality study of battery plant workers and lead smelter workers. They found statistically significant excesses for total cancer mortality (SMR=113, obs=344), stomach cancer (SMR=168, obs=34), and lung cancer (SMR=124, obs=109) in the battery plant workers. Although similar excesses were observed in the smelter workers, they were not statistically significant. Cooper and Gaffey (1975) felt it was possible that individual subjects were monitored primarily on the basis of obvious signs of lead exposure, while others who showed no symptoms of lead poisoning were not monitored.

All of the available studies lacked quantitative exposure information, as well as information on the possible contribution from smoking. All studies also included exposures to other metals such as arsenic, cadmium, and zinc for which no adjustment was done. The cancer excesses observed in the lung and stomach were relatively small (<200). There was no consistency of site among the various studies, and no study showed any dose-response relationship. Thus, the available human evidence is considered to be inadequate to refute or demonstrate any potential carcinogenicity for humans from lead exposure.

___II.A.3. ANIMAL CARCINOGENICITY DATA

Sufficient. The carcinogenic potential of lead salts (primarily phosphates and acetates) administered via the oral route or by injection has been demonstrated in rats and mice by more than 10 investigators. The most characteristic cancer response is bilateral renal carcinoma. Rats given lead acetate or subacetate orally have developed gliomas, and lead subacetate also produced lung adenomas in mice after i.p. adminstration. Most of these investigations found a carcinogenic response only at the highest dose. The lead compounds tested in animals are almost all soluble salts. Metallic lead, lead oxide and lead tetralkyls have not been tested adequately. Studies of inhalation exposure have not been located in the literature.

Azar et al. (1973) administerd 10, 50, 100, and 500 ppm lead as lead acetate in dietary concentrations to 50 rats/sex/group for 2 years. Control rats (100/sex) received the basal laboratory diet. In a second 2-year feeding study, 20 rats/group were given diets containing 0, 1000, and 2000 ppm lead as lead acetate. No renal tumors were reported in the control groups or in treated animals of either sex receiving 10 to 100 ppm. Male rats fed 500, 1000, and 2000 ppm lead acetate had an increased renal tumor incidence of 5/50, 10/20, and 16/20, while 7/20 females in the 2000-ppm group developed renal tumors.

The Azar et al. (1973) study is limited by the lack of experimental detail. The possibility of environmental contamination from lead in the air or drinking water was not mentioned. The strains of rats used were not specified in the study, but the Health Effects Assessment for Lead (U.S. EPA, 1984) indicates the rats were Wistar strain. The weight gain at 1000 and 2000 ppm was reported to be depressed, but details were not given.

Kasprzak et al. (1985), in investigating the interaction of dietary calcium on lead carcinogenicity, fed 1% lead subacetate (8500 ppm Pb) to male Sprague-Dawley rats in the diet for 79 weeks. Of the rats surviving (29/30) in this treatment group beyond 58 weeks, 44.8% had renal tumors. Four rats had adenocarcinomas; the remainaing nine had adenomas. Bilateral tumors were noted. No renal tumors were noted among the controls.

As part of a study to determine interactions between sodium nitrite, ethyl urea and lead, male Sprague-Dawley rats were given lead acetate in their drinking water for 76 weeks (Koller et al., 1986). The concentration of lead was 2600 ppm. No kidney tumors were detected among the 10 control rats. Thirteen of 16 (81%) lead-treated rats had renal tubular carcinoma; three tumors were detected at 72 weeks and the remainder detected at the termination of the study.

Van Esch and Kroes (1969) fed basic lead acetate at 0, 0.1%, and 1.0% in the diet to 25 Swiss mice/sex/group for 2 years. No renal tumors developed in the control group, but 6/25 male mice of 0.1% basic lead acetate group had renal tumors (adenomas and carcinomas combined). In the 1.0% group, one female had a renal tumor. The authors thought that the low incidence in the 1.0% group was due to early mortality.

Hamsters given lead subacetate at 0.5% and 1% in the diet had no significant renal tumor response (Van Esch and Kroes, 1969).

___II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

Lead acetate induces cell transformation in Syrian hamster embryo cells (DiPaolo et al., 1978) and also enhances the incidence of simian adenovirus induction. Lead oxide showed similar enhanced adenovirus induction (Casto et al., 1979).

Under certain conditions lead compounds are capable of inducing chromosomal aberrations in vivo and in tissue cultures. Grandjean et al. (1983) showed a relationship between SCE and lead exposure in exposed workers. Lead has been shown, in a number of DNA structure and function assays, to affect the molecular processes associated with the regulation of gene expression (U.S. EPA, 1986).

__II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

Not available.

Quantifying lead's cancer risk involves many uncertainties, some of which may be unique to lead. Age, health, nutritional state, body burden, and exposure duration influence the absorption, release, and excretion of lead. In addition, current knowledge of lead pharmacokinetics indicates that an estimate derived by standard procedures would not truly describe the potential risk. Thus, the Carcinogen Assessment Group recommends that a numerical estimate not be used.

__II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

Not available.

__II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

___II.D.1. EPA DOCUMENTATION

U.S. EPA. 1984. Health Effects Assessment for Lead. Prepared by the Office

of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH, for the Office of Emergency and Remedial Response, Washington, DC. EPA/540/1-86/055. NTIS PB85-163996/AS.

U.S. EPA. 1986. Air Quality Criteria Document for Lead. Volumes III, IV. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Research Triangle Park, NC, for the Office of Air Quality Planning and Standards. EPA-600/8-83/028dF.

U.S. EPA. 1987. Preliminary review of the carcinogenic potential of lead associated with oral exposure. Prepared by the Office of Health and Environmental Assessment, Carcinogenic Assessment Group, Washington DC, for the Office of Drinking Water, Office of Solid Waste and the Office of Emergency and Remedial Response (Superfund). OHEA-C-267. Internal Review Draft.

___II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The review of the carcinogenic potential of lead associated with oral exposure has received Agency review.

The 1986 Air Quality Criteria Document for Lead has received Agency and External Review.

Agency Work Group Review: 05/04/88

Verification Date: 05/04/88

___II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

William Pepelko / ORD -- (202)260-5898 / FTS 260-5898

James Cogliano / ORD -- (202)260-9243 / FTS 260-9243

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
At the end of each work shift.

** REMOVE CLOTHING:
Promptly remove non-impervious clothing that becomes contaminated.

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
OSHA (LEAD)
Not in excess of 0.5 mg/M3: Half-mask, air-purifying respirator equipped with high efficiency filters.
Not in excess of 2.5 mg/M3: Full facepiece air-purifying respirator equipped with high-efficiency filters.
Not in excess of 50 mg/M3: (1) Any powered, air-purifying respirator with high efficiency filters; or (2) Half-mask supplied-air respirator operated in positive-pressure mode.
Not in excess of 100 mg/M3: Supplied air respirator with full facepiece hood, or helmet or suit and operated in positive pressure mode.
Unknown concentration or Firefighting: Full facepiece, self-contained breathing apparatus operated in postive-pressure mode.

FIRST AID SOURCE: NIOSH
EYE: irr immed
SKIN: soap flush promptly
INHALATION: art resp
INGESTION: water, vomit

FIRST AID SOURCE: DOT Emergency Response Guide 1990.
Move victim to fresh air; call emergency medical care. In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes. Remove and isolate contaminated clothing and shoes at the site.

---------- INITIAL INCIDENT RESPONSE ----------

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: LEAD COMPOUNDS, SOLUBLE, N.O.S.
DOT ID NUMBER: UN2291

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POTENTIAL HAZARDS

*HEALTH HAZARDS
Poisonous if swallowed.
Inhalation of dust or mist may be poisonous.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.
*FIRE OR EXPLOSION
Some of these materials may burn, but none of them ignites readily.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry. Stay

upwind; keep out of low areas. Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC AT 1-800-424-9300. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
*SPILL OR LEAK
Do not touch or walk through spilled material; stop leak if you can do it without risk.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Small Dry Spills: With clean shovel place material into clean, dry container and cover loosely; move containers from spill area.
Large Spills: Dike far ahead of liquid spill for later disposal.
*FIRST AID
Move victim to fresh air; call emergency medical care. In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes. Remove and isolate contaminated clothing and shoes at the site.

CHEMTOX DATA

---------- IDENTIFIERS ----------

CHEMTOX RECORD 4731 LAST UPDATE OF THIS RECORD: 11/24/95
NAME: DIESEL FUEL
SYNONYMS: AUTOMOTIVE DIESEL OIL; DIESEL FUEL (DOT); DIESEL OIL (PETROLEUM); DIESEL OILS; DIESEL TEST FUEL; FUEL OIL, DIESEL (DOT); FUELS, DIESEL; NA 1993 (DOT); OLEJ NAPEDOWY III (Polish)
CAS: 68512-90-3 RTECS: HZ1800000
FORMULA: MOL WT:
WLN:
CHEMICAL CLASS:Aromatic hydrocarbon

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION: clear liquid
BOILING POINT: NA
MELTING POINT: NA
FLASH POINT: 322.15 K 49 C 120.2 F
AUTO IGNITION: Not available
VAPOR PRESSURE:
UEL: 7.5 %
LEL: 0.5 %
VAPOR DENSITY: > 4 (air=1)
SPECIFIC GRAVITY: 0.8
DENSITY: 0.8 g/cc or 7.44 lb/gal
WATER SOLUBILITY: NEGLIGIBLE
INCOMPATIBILITIES: strong oxidizers

REACTIVITY WITH WATER: No data on water reactivity
REACTIVITY WITH COMMON MATERIALS: No data
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: NIOSH has recommened that whole diesel exhaust be treated as an occupational carcinogen based on its effects on laboratory animals.
ODOR DETECTED AT (ppm): Unknown
ODOR DESCRIPTION: No data
100 % ODOR DETECTION: No data

---------- REGULATIONS ----------

DOT hazard class: 3 FLAMMABLE LIQUID
DOT guide: 27

Identification number:	UN1993
DOT shipping name:	FLAMMABLE LIQUIDS, N.O.S. (DIESEL FUEL)
Packing group:	III
Label(s) required:	FLAMMABL LIQUID
Special provisions:	B1, B52, T7, T30
Packaging exceptions:	173.150
Non bulk packaging:	173.203
Bulk packaging:	173.242
Quantity limitations-	
Passenger air/rail:	60 L
Cargo aircraft only:	220 L
Vessel stowage:	A
Other stowage provisions:	

STCC NUMBER:	4915113

CLEAN WATER ACT Sect.307:	No
CLEAN WATER ACT Sect.311:	No
CLEAN AIR ACT:	Not listed
EPA WASTE NUMBER:	D001
CERCLA REF:	
RQ DESIGNATION:	Not listed
SARA TPQ VALUE:	Not listed
SARA Sect. 312 categories:	Acute toxicity: Irritant Fire hazard: combustible. Chronic toxicity: carcinogen

UNITED STATED POSTAL SERVICE MAILABILITY:
Not given

NFPA CODES:

HEALTH HAZARD (BLUE)	:	(0) No unusual health hazard.
FLAMMABILITY (RED)	:	(2) This material must be moderately heated before ignition will occur.
REACTIVITY (YELLOW)	:	(0) Stable even under fire conditions.
SPECIAL	:	Unspecified

---------- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON ----------

DIESEL FUEL [68512-90-3]
DOT Hazardous Materials Table. 49 CFR 172.101
EPA TSCA Chemical Inventory List 1989
EPA TSCA Test Submission (TSCATS) Database - April 1990
RCRA Hazardous Waste

---------- TOXICITY DATA ----------

SHORT TERM TOXICITY: Unknown

LONG TERM TOXICITY: unknown

TARGET ORGANS: eyes, skin

SYMPTOMS: Inhalation of mist or high concentrations of vapor can produce dizziness, headache, nausea, and possibly irritation of the eyes, nose and throat. Source:

CONC IDLH: Nonegiven

NIOSH REL: Not given

ACGIH TLV: Not listed
ACGIH STEL: Not listed

OSHA PEL: Not in Table Z-1-A

MAK INFORMATION: ppm

CARCINOGEN?: N STATUS: See below

CARCINOGEN LISTS:
IARC: Not listed
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

LD50 value: orl-rat LD50:9 gm/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:9 gm/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):
This chemical has no known mammalian reproductive toxicity.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)

California Prop 65: Not listed

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

wear protective gloves and clothing. eye protection such as safety glasses recommended.

FIRST AID SOURCE: DOT Emergency Response Guide 1990.
Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

---------- INITIAL INCIDENT RESPONSE ----------

FIRE EXTINGUISHMENT: DRY CHEMICAL, CARBON DIOXIDE, HALOGENATED AGENTS, FOAM. Note: CHRIS91

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: FLAMMABLE LIQUIDS, N.O.S. (DIESEL FUEL)
DOT ID NUMBER: UN1993

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POTENTIAL HAZARDS

*FIRE OR EXPLOSION
Flammable/combustible material; may be ignited by heat, sparks or flames.
Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.
Vapor explosion hazard indoors, outdoors or in sewers.
Runoff to sewer may create fire or explosion hazard.
Material may be transported hot.
*HEALTH HAZARDS
May be poisonous if inhaled or absorbed through skin.
Vapors may cause dizziness or suffocation.
Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind; keep out of low areas. Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection. *Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC AT 1-800-424-9300. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. For massive

fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

*SPILL OR LEAK

Shut off ignition sources; no flares, smoking or flames in hazard area. Stop leak if you can do it without risk. Water spray may reduce vapor; but it may not prevent ignition in closed spaces.

Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.

Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

CHEMTOX DATA

---------- IDENTIFIERS ----------

CHEMTOX RECORD 206 LAST UPDATE OF THIS RECORD: 11/24/95

NAME: ETHYL BENZENE

SYNONYMS: AETHYLBENZOL (German); EB; ETHYLBENZEEN (Dutch); ETHYL BENZENE; ETHYL BENZENE (DOT); ETHYLBENZOL; ETILBENZENE (Italian); ETYLOBENZEN (Polish); NCI-C56393; PHENYLETHANE

CAS: 100-41-4 RTECS: DA0700000

FORMULA: C8H10 MOL WT: 106.18

WLN: 2R

CHEMICAL CLASS: Aromatic hydrocarbon

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION: colorless liquid with a sweet, gasoline-like odor.

BOILING POINT:	409.2 K	136 C	276.8 F
MELTING POINT:	178.15 K	-95 C	-139 F
FLASH POINT:	285.93 K	12.78 C	55 F
AUTO IGNITION:	733 K	459.8 C	859.8 F
CRITICAL TEMP:	617.1 K	343.95 C	651.11 F
CRITICAL PRESS:	3.61 kN/M2	35.5 atm	523 psia
HEAT OF VAP:	144 Btu/lb	79.97 cal/g	3.346x E5 J/kg
HEAT OF COMB:	-17780 Btu/lb	-9885 cal/g	-413x E5 J/kg

VAPOR PRESSURE: 10mm @ 25.9 C

UEL: 6.7 %

LEL: 1.0 %

IONIZATION POTENTIAL (eV): 8.76

VAPOR DENSITY: 3.7 (air=1)

EVAPORATION RATE: 0.84(n-BUTYL ACETATE=1)

SPECIFIC GRAVITY: 0.867 20C

DENSITY: 0.866 g/mL @ 20 C

WATER SOLUBILITY: 0.015%

INCOMPATIBILITIES: strong oxidizers

REACTIVITY WITH WATER: No data on water reactivity

REACTIVITY WITH COMMON MATERIALS: OXIDIZING MATERIALS Source: SAX

STABILITY DURING TRANSPORT: No Data

NEUTRALIZING AGENTS: No data

POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: None reported other than possible unburned vapors

ODOR DETECTED AT (ppm): 140

ODOR DESCRIPTION: AROMATIC Source:CHRIS

100 % ODOR DETECTION: No data

---------- REGULATIONS ----------

DOT hazard class: 3 FLAMMABLE LIQUID
DOT guide: 26
Identification number: UN1175
DOT shipping name: Ethylbenzene
Packing group: II
Label(s) required: FLAMMABLE LIQUID
Special provisions: T1
Packaging exceptions: 173.150
Non bulk packaging: 173.202
Bulk packaging: 173.242
Quantity limitations-
Passenger air/rail: 5 L
Cargo aircraft only: 60 L
Vessel stowage: B
Other stowage provisions:

STCC NUMBER: 4909163

CLEAN WATER ACT Sect.307:Yes
CLEAN WATER ACT Sect.311:Yes
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 0.7 mg/L (07/30/92)
Maximum Contaminant Level Goals (MCLG): 0.7 mg/L (07/30/92)
CLEAN AIR ACT: CAA '90 Listed
EPA WASTE NUMBER: D001
CERCLA REF: Y
RQ DESIGNATION: C 1000 pounds (454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Acute toxicity: Irritant
Acute toxicity: adverse effect to target organs.
Chronic toxicity: mutagen.
Chronic toxicity: reproductive toxin.
Fire hazard: flammable.
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 1.0 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: Flammable liquid - Mailable as ORM-D
Mailability: Domestic surface mail only
Max per parcel: 1 QT METAL; 1 PT OTHER

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON ----------

ACGIH TLV list "Threshold Limit Values for 1992-1993"
California Assembly Bill 1803 Well Monitoring Chemicals.
Canadian Domestic Substances List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
Clean Air Act Section 111 List.
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 307 Priority Pollutants
Clean Water Act Section 311 Hazardous Chemicals List.
DOT Hazardous Materials Table. 49 CFR 172.101
EPA Carcinogen Assessment Group List
EPA List of VOC chemicals from 40 CFR 60.489
EPA TSCA 8(a) Preliminary Assessment Information Rule - effective 11/19/82
EPA TSCA 8(d) Health and Safety Data Rule - effective date 06/19/87
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
ETHYL BENZENE [100-41-4]
Massachusetts Substance List.
New Jersey DEQ100 list for release reporting.
New Jersey Right To Know Substance List. (December 1987)
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
OSHA Process Safety Rule chemical with a TQ. Effective May 26, 1992
Pennsylvania Hazardous Substance List
RCRA Hazardous Constituents for Ground Water Monitoring. Ap'dx IX to 40 CFR 264
RCRA Hazardous Waste
SARA Section 313 Toxic Chemicals List
Superfund/CERCLA RQ list. Table 302.4 in 54 FR 50968 (December 11, 1989)
Wisconsin Air Toxics Control Regulation NR-445 (December 1988)

---------- TOXICITY DATA ----------

SHORT TERM TOXICITY: INHALATION: 200 ppm for 30 minutes can cause irritation of the nose and throat, dizziness, difficult breathing and depression. very high levels can cause unconsciousness. SKIN: can cause irritation, inflammation, blisters and burns. Eyes: 200 ppm can cause irritation. higher levels can cause burning, tearing and injury. INGESTION: can cause headache, sleepiness and coma.(NYDH)

LONG TERM TOXICITY: may cause skin rash and irritation of eyes, nose and throat.(NYDH)

TARGET ORGANS: eyes, upper resp sys, skin, CNS

SYMPTOMS: Inhalation may cause irritation of nose, dizziness,

depression. Moderate irritation of eye with corneal injury possible. Irritates skin and may cause blisters. Source: CHRIS

CONC IDLH: 800PPM

NIOSH REL:

ACGIH TLV: TLV = 100ppm(434 mg/M3)
ACGIH STEL: STEL = 125 ppm(543 mg/M3)

OSHA PEL: Transitional Limits:
PEL = 100 ppm(435mg/M3)
Final Rule Limits:
TWA = 100 ppm (435 mg/M3)
STEL = 125 ppm(545 mg/M3)

MAK INFORMATION: 100 ppm
440 mG/M3
Local irritant: Peak = 2xMAK for 5 minutes, 8 times per shift.
Danger of cutaneous absorption

CARCINOGEN?: N STATUS: See below

CARCINOGEN LISTS:
IARC: Not listed
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)
ihl-hmn TCLo:100 ppm/8H AIHAAP 31,206,70
SENSE ORGANS
Eye
Other
BEHAVIORAL
Sleep
LUNGS, THORAX, OR RESPIRATION
Other changes

LD50 value: orl-rat LD50:3500 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:3500 mg/kg
ihl-rat LCLo:4000 ppm/4H
ihl-mus LDLo:50 gm/m3/2H
ipr-mus LD50:2272 mg/kg
skn-rbt LD50:17800 mg/kg

ihl-gpg LCLo:10000 ppm

IRRITATION DATA: (Source: NIOSH RTECS 1992)

skn-rbt 15 mg/24H open MLD
eye-rbt 100 mg

Reproductive toxicity (1992 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)
ihl-rat TCLo:97 ppm/7H (15D pre) NTIS** PB83-208074
EFFECTS ON FERTILITY
Female fertility index

ihl-rat TCLo:985 ppm/7H (1-19D preg) NTIS** PB83-208074
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-rat TCLo:96 ppm/7H (1-19D preg) NTIS** PB83-208074
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:600 mg/m3/24H (7-15D preg) ATSUDG 8,425,85
EFFECTS ON FERTILITY
Post-implantation mortality
EFFECTS ON EMBRYO OR FETUS
Fetal death
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:2400 mg/m3/24H (7-15D preg) ATSUDG 8,425,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-rbt TCLo:99 ppm/7H (1-18D preg) NTIS** PB83-208074
EFFECTS ON FERTILITY
Litter size(# fetuses per litter;measured before birth)

ihl-rbt TCLo:500 mg/m3/24H (7-20D preg) ATSUDG 8,425,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

California Prop 65: Not listed

---------- EPA's IRIS DATA SUMMARY ----------
Ethylbenzene; CASRN 100-41-4 (04/01/92)

_II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Ethylbenzene
CASRN -- 100-41-4

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quantitative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

__II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

___II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- D; not classifiable as to human carcinogenicity.

Basis -- nonclassifiable due to lack of animal bioassays and human studies.

___II.A.2. HUMAN CARCINOGENICITY DATA

None.

___II.A.3. ANIMAL CARCINOGENICITY DATA

None. NTP has plans to initiate bioassay. Metabolism and excretion studies at 3.5, 35 and 350 mg/kg are to be conducted as well.

___II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

The metabolic pathways for humans and rodents are different (Engstrom et al., 1984). Major metabolites in humans, mandelic acid and phenylglyoxylic acid, are minor metabolites in rats and rabbits (Kiese and Lenk, 1974). The major animal metabolites were not detected in the urine of exposed workers (Engstrom et al., 1984).

Ethylbenzene at 0.4 mg/plate was not mutagenic for Salmonella strains TA98, TA1535, TA1537 and TA1538 with or without Aroclor 1254 induced rat

liver homogenates (S9) (Nestmann et al., 1980). Ethylbenzene was shown to increase the mean number of sister chromatid exchanges in human whole blood lymphocyte culture at the highest dose examined without any metabolic activation system (Norppa and Vainio, 1983).

Dean et al. (1985) used a battery of short-term tests including bacterial mutation assays, mitotic gene conversion in Saccharomyces cerevisiae JD1 in the presence and absence of S9 and chromosomal damage in a cultured rat liver cell line. Ethylbenzene was not mutagenic in the range of concentrations tested (0.2, 2, 20, 50 and 200 ug/plate) for S. typhimurium TA98, TA100, TA1535, TA1537 and TA1538 or for Escherichia coli WP2 and WP2uvrA. Ethylbenzene also showed no response in the S. cerevisiae JD1 gene conversion assay. In contrast, ethylbenzene hydroperoxide showed positive responses with E. coli WP2 at 200 ug/plate in the presence of S9 and an equally significant response with the gene conversion system of yeast.

__II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

Not available.

__II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

Not available.

__II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

___II.D.1. EPA DOCUMENTATION

U.S. EPA. 1980. Ambient Water Quality Criteria Document for Ethylbenzene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Water Regulations and Standards, Washington, DC. EPA 440/5-80-048. NTIS PB 81-117590.

U.S. EPA. 1984. Health Effects Assessment for Ethylbenzene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Emergency and Remedial Response, Washington, DC. EPA/540/1-86/008.

U.S. EPA. 1987. Drinking Water Criteria Document for Ethylbenzene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Drinking Water, Washington, DC.

___II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The Ambient Water Quality Criteria Document and the Health Assessment Document have received Agency and external review. The Drinking Water Criteria Document has been extensively reviewed.

Agency Work Group Review: 10/07/87

Verification Date: 10/07/87

___II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

Arthur S. Chiu / ORD -- (202)260-6764 / FTS 260-6764

Lynn Papa / ORD -- (513)569-7523 / FTS 684-7523

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:
self-contained breathing apparatus; safety goggles.

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly when skin becomes contaminated.

** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammability

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
OSHA (ETHYL BENZENE)
1000 ppm: Any powered air-purifying respirator with organic vapor

cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any supplied-air respirator. * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus. * Substance reported to cause eye irritation or damage may require eye protection. / Any chemical cartridge respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection.
2000 ppm: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any supplied-air respirator with a full facepiece. / Any self-contained breathing apparatus with a full facepiece.
EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.: Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID SOURCE: CHRIS Manual 1991
INHALATION: if ill effects occur, remove victim to fresh air, keep him warm and quiet, and get medical help promptly; if breathing stops, give artificial respiration.
INGESTION: induce vomiting only upon physician's approval; material in lung may cause chemical pneumonitis.
SKIN AND
EYES: promptly flush with plenty of water (15 min. for eyes) and get medical attention; remove and wash contaminated clothing before reuse.

FIRST AID SOURCE: DOT Emergency Response Guide 1990.
Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

---------- INITIAL INCIDENT RESPONSE ----------

FIRE EXTINGUISHMENT: Foam (most effective), water fog, carbon dioxide or dry chemical. CHRIS91

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: Ethylbenzene
DOT ID NUMBER: UN1175

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POTENTIAL HAZARDS

*FIRE OR EXPLOSION
Flammable/combustible material; may be ignited by heat, sparks or flames.

Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.
Vapor explosion hazard indoors, outdoors or in sewers.
Runoff to sewer may create fire or explosion hazard.
*HEALTH HAZARDS
May be poisonous if inhaled or absorbed through skin.
Vapors may cause dizziness or suffocation.
Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may give off poisonous gases and cause water pollution.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry.
Stay upwind; keep out of low areas. Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection. *Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC AT 1-800-424-9300. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO2, water spray or alcohol-resistant foam. Do not use dry chemical extinguishers to control fires involving nitromethane or nitroethane. Large Fires: Water spray, fog or alcohol-resistant foam. Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.
*SPILL OR LEAK
Shut off ignition sources; no flares, smoking or flames in hazard area.
Stop leak if you can do it without risk.
Water spray may reduce vapor; but it may not prevent ignition in closed spaces.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.
*FIRST AID
Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

or omissions within this database, or in any of its printed or displayed output forms.

CHEMTOX DATA

---------- IDENTIFIERS ----------

CHEMTOX RECORD 59 LAST UPDATE OF THIS RECORD: 11/24/95

NAME: BENZENE

SYNONYMS: BENZOL; CYCLOHEXATRIENE; PHENYL HYDRIDE; PHENE; COAL NAPHTHA; PYROBENZOL

CAS: 71-43-2 RTECS: CY1400000

FORMULA: C6H6 MOL WT: 78.11

WLN: RH

CHEMICAL CLASS: Aromatic hydrocarbon

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION: colorless to pale yellow watery liquid with a gasoline-like odor

BOILING POINT:	353.15 K	80 C	176 F
MELTING POINT:	278.71 K	5.5 C	42 F
FLASH POINT:	262 K	-11.15 C	11.9 F
AUTO IGNITION:	864.8 K	591.6 C	1097 F
CRITICAL TEMP:	562.1 K	288.95 C	552.11 F
CRITICAL PRESS:	4.89 kN/M2	48.2 atm	708 psia
HEAT OF VAP:	169 Btu/lb	93.85 cal/g	3.927x E5 J/kg
HEAT OF COMB:	-17460 Btu/lb	-9707 cal/g	-406x E5 J/kg

VAPOR PRESSURE: 75 mm @ 20 C

UEL: 7.1 %

LEL: 1.3 %

IONIZATION POTENTIAL (eV): 9.25

VAPOR DENSITY: 2.77 (air=1)

EVAPORATION RATE: 3.50(n-BUTYL ACETATE=1)

SPECIFIC GRAVITY: 0.86-0.88 20 C

DENSITY: 0.8794 @ 20 C

WATER SOLUBILITY: 0.06%

INCOMPATIBILITIES: strong ox,chlorine,bromine with iron; many fluorides and perchlorates, nitric acid

REACTIVITY WITH WATER: No data on water reactivity

REACTIVITY WITH COMMON MATERIALS: OXIDIZING MATERIALS(Br2, F2, CL2, CrO3, NaClO4, O2, O3), PERCHLORATES (AlCl3 +NaClO4), (H2SO4 & PERMANGANATES), K2O2, (AgClO4 & ACETIC ACID), Na2O2 Source: SAX

STABILITY DURING TRANSPORT: No Data

NEUTRALIZING AGENTS: No data

POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: VAPOR IS HEAVIER THAN AIR AND MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE

OF IGNITION AND FLASH BACK.

ODOR DETECTED AT (ppm):	4.68 ppm
ODOR DESCRIPTION:	odor; characteristic odor Source:CHRIS
100 % ODOR DETECTION:	No data

---------- REGULATIONS ----------

DOT hazard class:	3 FLAMMABLE LIQUID
DOT guide:	27
Identification number:	UN1114
DOT shipping name:	Benzene
Packing group:	II
Label(s) required:	FLAMMABLE LIQUID
Special provisions:	T8
Packaging exceptions:	173.150
Non bulk packaging:	173.202
Bulk packaging:	173.242
Quantity limitations-	
Passenger air/rail:	5 L
Cargo aircraft only:	60 L
Vessel stowage:	B
Other stowage provisions:	40

STCC NUMBER:	4908110

CLEAN WATER ACT Sect.307:	Yes
CLEAN WATER ACT Sect.311:	Yes
National Primary Drinking Water Regulations	
Maximum Contaminant Levels (MCL):	0.005 mg/L (01/09/89)
Maximum Contaminant Level Goals (MCLG):	0 mg/L (01/09/89)
CLEAN AIR ACT:	CAA '90 Listed and CAA '77 Sect 109
EPA WASTE NUMBER:	U019,D018,D001
CERCLA REF:	Y
RQ DESIGNATION:	A 10 pounds (4.54 kg) CERCLA
SARA TPQ VALUE:	Not listed
SARA Sect. 312 categories:	Acute toxicity: Irritant Acute toxicity: adverse effect to target organs. Chronic toxicity: carcinogen Chronic toxicity: mutagen. Chronic toxicity: reproductive toxin. Fire hazard: flammable.
LISTED IN SARA Sect 313:	Yes
de minimus CONCENTRATION:	0.1 percent

UNITED STATED POSTAL SERVICE MAILABILITY:

Hazard class:	Not given
Mailability:	Nonmailable
Max per parcel:	0

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON ----------

ACGIH TLV list "Threshold Limit Values for 1992-1993"
ATSDR Toxicology Profile available (NTIS** PB/89/209464/AS)
BENZENE [71-43-2]
California OSHA Carcinogens List.
California Assembly Bill 1803 Well Monitoring Chemicals.
California Assembly Bill 2588 Air Toxics "Hot Spots" Chemicals.
California Assembly Bill 1807 Toxic Air Contaminants.
Canadian Domestic Substances List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
Clean Air Act Section 111 List.
Clean Air Act Section 112 Hazardous Air Pollutants List.
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 307 Priority Pollutants
Clean Water Act Section 311 Hazardous Chemicals List.
DOT Hazardous Materials Table. 49 CFR 172.101
DOT Marine Pollutant. Proposed list. 57 FR 3854, Jan 31, 1992
EPA Carcinogen Assessment Group List
EPA List of VOC chemicals from 40 CFR 60.489
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
Massachusetts Substance List.
National Toxicology Program (NTP) list of human carcinogens
New Jersey Right To Know Substance List. (December 1987)
New Jersey Right to Know Substance List. Listed as a carcinogen.
New Jersey Right to Know Substance List. Listed as a mutagen.
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
OSHA Process Safety Rule chemical with a TQ. Effective May 26, 1992
OSHA Specifically regulated substance. See 29 CFR 1910.1028
Pennsylvania Hazardous Substance List
RCRA Hazardous Constituents for Ground Water Monitoring. Ap'dx IX to 40 CFR 264
RCRA Hazardous Waste
RCRA Toxicity Characteristics (TC) list dated March 29, 1990
SARA Section 313 Toxic Chemicals List
Superfund/CERCLA RQ list. Table 302.4 in 54 FR 50968 (December 11, 1989)
Suspected carcinogen (ACGIH). "Threshold Limit Values for 1992-1993"
Washington State Discarded Chemical Products List, November 17, 1989
Wisconsin Air Toxics Control Regulation NR-445 (December 1988)

TOXICITY DATA

SHORT TERM TOXICITY: INHALATION: benzene may produce both nerve and blood effects. irritation of the nose, throat and lungs may occur (3,000 ppm may be tolerated for only 30 to 60 minutes). lung congestion may occur. nerve effects may include an exaggerated feeling of well-being, excitement, headache, dizziness and slurred speech. at high levels, slowed breathing and death may result. death has occurred at 20,000 ppm for 5 to 10 minutes, or 7,500 ppm for 30 minutes. SKIN: irritation may occur, with redness and blistering if not promptly removed. benzene is poorly absorbed. whole body exposure for 30 minutes has been reported with no health effects. Eyes: may cause severe irritation. INGESTION: may cause irritation of mouth, throat and stomach. symptoms are similar to those listed under inhalation. one tablespoon may cause collapse, bronchitis, pneumonia and death.(NYDH)

LONG TERM TOXICITY: may cause loss of appetite, nausea, weight loss, fatigue, muscle weakness, headache, dizziness, nervousness and irritability. mild anemia has been reported from exposures of 25 ppm for several years and 100 ppm for 3 months. at levels between 100 and 200 ppm for periods of 6 months, or more, severe irreversible blood changes and damage to liver and heart may occur. temporary partial paralysis has been reported.(NYDH)

TARGET ORGANS: blood, CNS, skin, bone marrow, eyes, resp sys, skin [leukemia]

SYMPTOMS: Dizziness, excitation, pallor, followed by flushing, weakness, headache, breathlessness, chest constriction. Coma and possible death. Source: CHRIS

CONC IDLH: 500ppm

NIOSH REL: Potential occupational carcinogen 0.1 ppm Time weighted averages for 8-hour exposure 0.32 mg/M3 Time weighted averages for 8-hour exposure 1 ppm Ceiling exposures which shall at no time be exceeded 3.2 mg/M3 Ceiling exposures which shall at no time be exceeded

ACGIH TLV: TLV = 10ppm Suspected human carcinogen (A2)
ACGIH STEL: Suspected human carcinogen (A2)

OSHA PEL: Final Rule Limits:
TWA = 1 ppm
STEL = 5 ppm
CONSULT 29CFR 1910.1028

MAK INFORMATION: Danger of cutaneous absorption
Carcinogenic working material without MAK
Capable of inducing malignant tumors as shown by experience with humans.

CARCINOGEN?: Y STATUS: See below
REFERENCES:

HUMAN SUSPECTED IARC** 7,203,74
HUMAN SUSPECTED IARC** 28,151,82
ANIMAL SUSPECTED IARC** 28,151,82
ANIMAL SUSPECTED IARC** 29,93,82
HUMAN POSITIVE IARC** 29,93,82
ANIMAL INDEFINITE IARC** 7,203,74

CARCINOGEN LISTS:

IARC: Carcinogen as defined by IARC as carcinogenic to humans, with sufficient epidemiological evidence.
MAK: Capable of inducing malignant tumors as shown by experience in humans.
NIOSH: Carcinogen defined by NIOSH with no further categorization.
NTP: Carcinogen defined by NTP as known to be carcinogenic, with evidence from human studies.
ACGIH: Carcinogen defined by ACGIH TLV Committee as a suspected carcinogen, based on either limited epidemological evidence or demonstration of carcinogenicity in experimental animals.
OSHA: Cancer hazard

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)

* ihl-hmn LCLo:2 pph/5M TABIA2 3,231,33

* orl-man LDLo:50 mg/kg YAKUD5 22,883,80

* ihl-hmn LCLo:2000 ppm/5M YAKUD5 22,883,80

ihl-man TCLo:150 ppm/1Y-I BLUTA9 28,293,74
BLOOD
Other changes
NUTRITIONAL AND GROSS METABOLIC
Changes in:
Body temperature increase

ihl-hmn TCLo:100 ppm INMEAF 17,199,48
BEHAVIORAL
Somnolence(general depressed activity)

GASTROINTESTINAL
Nausea or vomiting
SKIN AND APPENDAGES
Skin - after systemic exposure
Dermatitis,other

ihl-hmn LCLo:65 mg/m3/5Y ARGEAR 44,145,74
BLOOD
Other changes

LD50 value: orl-rat LD50:930 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:930 mg/kg
ihl-rat LC50:10000 ppm/7H
ipr-rat LD50:2890 ug/kg
orl-mus LD50:4700 mg/kg
ihl-mus LC50:9980 ppm
ipr-mus LD50:340 mg/kg
orl-dog LDLo:2 gm/kg
ihl-dog LCLo:146000 mg/m3
ihl-cat LCLo:170000 mg/m3
ihl-rbt LCLo:45000 ppm/30M
skn-rbt LD50:>9400 mg/kg
ivn-rbt LDLo:88 mg/kg
skn-gpg LD50:>9400 mg/kg
ipr-gpg LDLo:527 mg/kg
scu-frg LDLo:1400 mg/kg
ihl-mam LCLo:20000 ppm/5M
ipr-mam LDLo:1500 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)
ihl-rat TCLo:670 mg/m3/24H (15D pre/1-22D preg) HYSAAV 33(1-3),327,68
EFFECTS ON FERTILITY
Female fertility index

ihl-rat TCLo:56600 ug/m3/24H (1-22D preg) HYSAAV 33(7-9),112,68
EFFECTS ON NEWBORN

ihl-rat TCLo:50 ppm/24H (7-14D preg) JHEMA2 24,363,80
EFFECTS ON EMBRYO OR FETUS
Extra embryonic features(e.g.,placenta,umbilical cord)

EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-rat TCLo:150 ppm/24H (7-14D preg) JHEMA2 24,363,80
EFFECTS ON FERTILITY
Post-implantation mortality
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

orl-mus TDLo:9 gm/kg (6-15D preg) TJADAB 19,41A,79
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

orl-mus TDLo:12 gm/kg (6-15D preg) TJADAB 19,41A,79
EFFECTS ON FERTILITY
Post-implantation mortality

orl-mus TDLo:6500 mg/kg (8-12D preg) TCMUD8 6,361,86
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)

ihl-mus TCLo:500 ppm/7H (6-15D preg) AIHAAP 40,993,79
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-mus TCLo:500 mg/m3/12H (6-15D preg) ATSUDG 8,425,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-mus TCLo:5 ppm (6-15D preg) TXCYAC 42,171,86
EFFECTS ON EMBRYO OR FETUS
Cytological changes(including somatic cell genetic material)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Blood and lymphatic systems(including spleen and marrow)

ihl-mus TCLo:20 ppm/6H (6-15D preg) FAATDF 10,224,88
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Blood and lymphatic systems(including spleen and marrow)

ipr-mus TDLo:5 mg/kg (1D male) TPKVAL 15,30,79
EFFECTS ON FERTILITY
Pre-implantation mortility
EFFECTS ON EMBRYO OR FETUS
Fetal death

ipr-mus TDLo:219 mg/kg (14D preg) EMMUEG 18,1,91

SPECIFIC DEVELOPMENTAL ABNORMALITIES
Blood and lymphatic systems(including spleen and marrow)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Hapatobilinary system

scu-mus TDLo:1100 mg/kg (12D preg) TOXID9 1,125,81
EFFECTS ON EMBRYO OR FETUS
Other effects on embryo or fetus

scu-mus TDLo:7030 mg/kg (12-13D preg) SEIJBO 15,47,75
EFFECTS ON EMBRYO OR FETUS
Extra embryonic features(e.g.,placenta,umbilical cord)
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ivn-mus TDLo:13200 ug/kg (13-16D preg) ICHUDW 4(6),24,82
EFFECTS ON EMBRYO OR FETUS
Cytological changes(including somatic cell genetic material)

par-mus TDLo:4 gm/kg (12D preg) NEZAAQ 25,438,70
EFFECTS ON NEWBORN
Weaning or lactation index(#alive at weaning per # alive at day 4)

ihl-rbt TCLo:1 gm/m3/24H (7-20D preg) ATSUDG 8,425,85
EFFECTS ON FERTILITY
Post-implantation mortality
EFFECTS ON FERTILITY
Abortion
EFFECTS ON EMBRYO OR FETUS
Fetal death

California Prop 65: Carcinogen (02/27/87)
No significant risk level 7. ugD (01/01/94)

---------- EPA's IRIS DATA SUMMARY ----------

Benzene; CASRN 71-43-2 (04/01/92)

_II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Benzene
CASRN -- 71-43-2
Last Revised -- 04/01/92

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quant-

itative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

__II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

___II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- A; human carcinogen

Basis -- Several studies of increased incidence of nonlymphocytic leukemia from occupational exposure, increased incidence of neoplasia in rats and mice exposed by inhalation and gavage, and some supporting data form the basis for this classification.

___II.A.2. HUMAN CARCINOGENICITY DATA

Aksoy et al. (1974) reported effects of benzene exposure among 28,500 Turkish workers employed in the shoe industry. Mean duration of employment was 9.7 years (1-15 year range) and mean age was 34.2 years. Peak exposure was reported to be 210-650 ppm. Twenty-six cases of leukemia and a total of 34 leukemias or preleukemias were observed, corresponding to an incidence of 13/100,000 (by comparison to 6/100,000 for the general population). A follow-up paper (Aksoy, 1980) reported eight additional cases of leukemia as well as evidence suggestive of increases in other malignancies.

In a retrospective cohort mortality study Infante et al. (1977a,b) examined leukemogenic effects of benzene exposure in 748 white males exposed while employed in the manufacturing of rubber products. Exposure occurred from 1940-1949, and vital statistics were obtained through 1975. A statistically significant increase (p less than or equal to 0.002) of leukemias was found by comparison to the general U.S. population. There was no evidence of solvent exposure other than benzene. Air concentrations were generally found to be below the recommended limits in effect during the study period.

In a subsequent retrospective cohort mortality study Rinsky et al. (1981) observed seven deaths from leukemia among 748 workers exposed to benzene and followed for at least 24 years (17,020 person-years). This increased incidence was statistically significant; standard mortality ratio (SMR) was

560. For the five leukemia deaths that occurred among workers with more than 5 years exposure, the SMR was 2100. Exposures (which ranged from 10-100 ppm 8-hour TWA) were described as less than the recommended standards for the time period of 1941-1969.

In an updated version of the Rinsky et al. (1981) study, the authors followed the same cohort to 12/31/81 (Rinsky et al., 1987). An in his earlier study, cumulative exposure was derived from historic air-sampling data or interpolated estimates based on exisitng data. Standardized mortality rates ranged from 109 at cumulative benzene exposures under 40 ppm-years and increased montonically to 6637 (6 cases) at 400 ppm-years or more. The authors found significantly elevated risks of leukemia at cumulative exposures less than the equivalent current standard for occupational exposure which is 10 ppm over a 40-year working lifetime.

Ott et al. (1978) observed three deaths from leukemia among 594 workers followed for at least 23 years in a retrospective cohort mortality study, but the increase was not statistically significant. Exposures ranged from <2 to >25 ppm 8-hour TWA.

Wong et al. (1983) reported on the mortality of male chemical workers who had been exposed to benzene for at least 6 months during the years 1946-1975. The study population of 4062 persons was drawn from seven chemical plants, and jobs were categorized as to peak exposure. Those with at least 3 days/week exposure (3036 subjects) were further categorizeed on the basis of an 8-hour TWA. The control subjects held jobs at the same plants for at least 6 months but were never subject to benzene exposure. Dose-dependent increases were seen in leukemia and lymphatic and hematopoietic cancer. The incidence of leukemia was responsible for the majority of the increase. It was noted that the significance of the increase is due largely to a less than expected incidence of neoplasia in the unexposed subjects.

Numerous other epidemiologic and case studies have reported an increased incidence or a causal relationship between leukemia and exposure to benzene (IARC, 1982).

___II.A.3. ANIMAL CARCINOGENICITY DATA

Both gavage and inhalation exposure of rodents to benzene have resulted in development of neoplasia. Maltoni and Scarnato (1979) and Maltoni et al. (1983) administered benzene by gavage at dose levels of 0, 50, 250, and 500 mg/kg bw to 30-40 Sprague-Dawley rats/sex for life. Dose-related increased incidences of mammary tumors were seen in females and of Zymbal gland carcinomas, oral cavity carcinomas and leukemias/lymphomas in both sexes.

In an NTP (1986) study, benzene was administered by gavage doses of 0, 50, 100, or 200 mg/kg bw to 50 F344/N rats/sex or 0, 25, 50, or 100 mg/kg bw to 50 B6C3F1 mice/sex. Treatment was 5 times/week for 103 weeks. Significantly increased incidences ($p<0.05$) of various neoplasic growths were seen in both sexes of both species. Both male and female rats and mice had increased incidence of carcinomas of the Zymbal gland. Male and female rats had oral

cavity tumors, and males showed increased incidences of skin tumors. Mice of both sexes had increased incidence of lymphomas and lung tumors. Males were observed to have harderian and preputial gland tumors and females had tumors of mammary gland and ovary. In general, the increased incidence was dose-related.

Slightly increased incidences of hematopoietic neoplasms were reported for male C57Bl mice exposed by inhalation to 300 ppm benzene 6 hours/day, 5 days/week for 488 days. There was no increase in tumor incidence in male AKR or CD-1 mice similarly exposed to 100 ppm or 100 or 300 ppm benzene, respectively. Likewise male Sprague-Dawley rats exposed by inhalation to 300 ppm benzene were not observed to have increased incidence of neoplasia (Snyder et al., 1981).

Maltoni et al. (1983) treated male and female Sprague-Dawley rats in the following manner. Starting at 13 weeks of age rats were exposed to 200 ppm benzene 4 hours/day, 5 days/week for 7 weeks; 200 ppm 7 hours/day, 5 days/week for 12 weeks; 300 ppm 7 hours/day, 5 days/week for 85 weeks. An 8-hour/day TWA for 5 days/week was calculated to be 241 ppm. A statistically significant increase was noted in hepatomas and carcinomas of the Zymbal gland.

___II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

Numerous investigators have found significant increases in chromosomal aberrations of bone marrow cells and peripheral lymphocytes from workers with exposure to benzene (IARC, 1982). Benzene also induced chromosomal aberrations in bone marrow cells from rabbits (Kissling and Speck, 1973), mice (Meyne and Legator, 1980) and rats (Anderson and Richardson, 1979). Several investigators have reported positive results for benzene in mouse micronucleus assays (Meyne and Legator, 1980). Benzene was not mutagenic in several bacterial and yeast systems, in the sex-linked recessive lethal mutation assay with Drosophila melanogaster or in mouse lymphoma cell forward mutation assay.

__II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

___II.B.1. SUMMARY OF RISK ESTIMATES

Oral Slope Factor -- 2.9E-2 per (mg/kg)/day

Drinking Water Unit Risk -- 8.3E-7 per (ug/L)

Extrapolation Method -- One-hit (pooled data)

Drinking Water Concentrations at Specified Risk Levels:

Risk Level	Concentration

E-4 (1 in 10,000)	1E+2 ug/L
E-5 (1 in 100,000)	1E+1 ug/L
E-6 (1 in 1,000,000)	1E+0 ug/L

___II.B.2. DOSE-RESPONSE DATA (CARCINOGENICITY, ORAL EXPOSURE)

Tumor Type -- leukemia
Test Animals -- human
Route -- inhalation, occupational exposure
Reference -- Rinsky et al., 1981; Ott et al., 1978; Wong et al., 1983

The slope factor was derived from human data for inhalation exposure (see dose-response data for inhalation quantitative estimate). The human respiratory rate was assumed to be 20 cu.m/day and the human drinking water intake was assumed to be 2 L/day. The fraction of the administered dose absorbed systemically via inhalation and via drinking water were assumed to be equal.

___II.B.3. ADDITIONAL COMMENTS (CARCINOGENICITY, ORAL EXPOSURE)

The unit risk estimate is the geometric mean of four ML point estimates using pooled data from the Rinsky et al. (1981) and Ott et al. (1978) studies, which was then adjusted for the results of the Wong et al. (1983) study as described in the additional comments section for inhalation data.

The unit risk should not be used if the water concentration exceeds 1E+4 ug/L, since above this concentration the unit risk may not be appropriate.

___II.B.4. DISCUSSION OF CONFIDENCE (CARCINOGENICITY, ORAL EXPOSURE)

The pooled cohorts were sufficiently large and were followed for an adequate time period. The increases in leukemias were statistically significant and dose-related in one of the studies. Wong et al. (1983) disagrees that exposures reported in Rinsky et al. (1981) were within the recommended standards. For the five leukemia deaths in persons with 5 or more years exposure, the author notes that mean exposure levels (range 15-70 ppm) exceeded the recommended standard (25 ppm) in 75% of the work locations sampled. A total of 21 unit risk estimates were prepared using 6 models and various combinations of the epidemiologic data. These range over slightly more than one order of magnitude. A geometric mean of these estimates is 2.7E-2. Regression models give an estimate similar to the geometric mean.

The risk estimate above based on reconsideration of the Rinsky et al. (1981) and Ott et al. (1978) studies is very similar to that of 2.4E-2/ppm (cited in U.S. EPA, 1980) based on Infante et al. (1977a,b), Ott et al. (1978) and Aksoy et al. (1974). It was felt by the authors of U.S. EPA (1985) that

the exposure assessment provided by Aksoy was too imprecise to warrant inclusion in the current risk estimate.

Risk estimates based on animal gavage studies are about 5 times higher than those derived from human data. Pharmacokinetic data which could impact the risk assessment are currently being evaluated.

II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

II.C.1. SUMMARY OF RISK ESTIMATES

Inhalation Unit Risk -- 8.3E-6 per (ug/cu.m)

Extrapolation Method -- One-hit (pooled data)

Air Concentrations at Specified Risk Levels:

Risk Level	Concentration
E-4 (1 in 10,000)	1E+1 ug/cu.m
E-5 (1 in 100,000)	1E+0 ug/cu.m
E-6 (1 in 1,000,000)	1E-1 ug/cu.m

II.C.2. DOSE-RESPONSE DATA FOR CARCINOGENICITY, INHALATION EXPOSURE

Tumor Type -- leukemia
Test Animals -- humans
Route -- inhalation, occupational exposure
Reference -- Rinsky et al., 1981; Ott et al., 1978; Wong et al., 1983

II.C.3. ADDITIONAL COMMENTS (CARCINOGENICITY, INHALATION EXPOSURE)

The unit risk estimate is the geometric mean of four ML point estimates using pooled data from the Rinsky et al. (1981) and Ott et al. (1978) studies, which was then adjusted for the results of the Wong et al. (1983) study. The Rinsky data used were from an updated tape which reports one more case of leukemia than was published in 1981. Equal weight was given to cumulative dose and weighted cumulative dose exposure categories as well as to relative and absolute risk model forms. The results of the Wong et al. (1983) study were incorporated by assuming that the ratio of the Rinsky-Ott-Wong studies to the Rinsky-Ott studies for the relative risk cumulative dose model was the same as for other model-exposure category combinations and multiplying this ratio by the Rinsky-Ott geometric mean. The age-specific U.S. death rates for 1978 (the most current year available) were used for background leukemia and

total death rates. It should be noted that a recently published paper (Rinsky et al., 1987) reported yet another case of leukemia from the study population.

The unit risk should not be used if the air concentration exceeds 100 ug/cu.m, since above this concentration the unit risk may not be appropriate.

___II.C.4. DISCUSSION OF CONFIDENCE (CARCINOGENICITY, INHALATION EXPOSURE)

The pooled cohorts were sufficiently large and were followed for an ade quate time period. The increases in leukemias were statistically significant and dose-related in one of the studies. Wong et al. (1983) disagrees that exposures reported in Rinsky et al. (1981) were within the recommended standards. For the five leukemia deaths in persons with 5 or more years exposure, the author notes that mean exposure levels (range 15-70 ppm) exceeded the recommended standard (25 ppm) in 75% of the work locations sampled. The risk estimate above based on reconsideration of the Rinsky et al. (1981) and Ott et al. (1978) studies is very similar to that of 2.4E-2/ppm (cited in U.S. EPA, 1980) based on Infante et al. (1977a,b), Ott et al. (1978) and Aksoy et al. (1974). It was felt by the authors of U.S. EPA (1985) that the exposure assessment provided by Aksoy was too imprecise to warrant inclusion in the current risk estimate. A total of 21 unit risk estimates were prepared using 6 models and various combinations of the epidemiologic data. These range over slightly more than one order of magnitude. A geometric mean of these estimates is 2.7E-2/ppm. Regression models give an estimate similar to the geometric mean.

__II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

___II.D.1. EPA DOCUMENTATION

U.S. EPA. 1980. Ambient Water Quality Criteria Document for Benzene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office (Cincinnati, OH) and Carcinogen Assessment Group (Washington, DC), and the Environmental Research Labs (Corvalis, OR; Duluth, MN; Gulf Breeze, FL) for the Office of Water Regulations and Standards, Washington, DC. EPA 440/5-80-018.

U.S. EPA. 1985. Interim Quantitative Cancer Unit Risk Estimates Due to Inhalation of Benzene. Prepared by the Office of Health and Environmental Assessment, Carcinogen Assessment Group, Washington, DC for the Office of Air Quality Planning and Standards, Washington, DC.

U.S. EPA. 1987. Memorandum from J. Orme, HEB, CSD/ODW to C. Vogt, Criteria and Standards Division, ODW, June, 1987.

___II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The 1985 Interim Evaluation was reviewed by the Carcinogen Assessment Group.

The 1987 memorandum is an internal document.

Agency Work Group Review: 03/05/87, 10/09/87

Verification Date: 10/09/87

___II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

D.L. Bayliss / ORD -- (202)260-5726 / FTS 260-5726

R. McGaughy / ORD -- (202)260-5898 / FTS 260-5898

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:
hydrocarbon vapor canister, supplied air or hose mask; hydrocarbon-insoluble rubber or plastic gloves; chemical goggles or face splash shield; hydrocarbon-insoluble apron such as neoprene.

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly wash with soap when skin becomes contaminated.

** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammability

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
OSHA (BENZENE)
Less than or equal to 10 ppm: Half-mask air-purifying respirator with organic vapor cartridge.
Less than or equal to 50 ppm: Full facepiece respirator with organic vapor cartridges. / Full facepiece gas mask with chin style canister.

Less than or equal to 100 ppm: Full facepiece powered air-purifying respirator with organic vapor canister.
Less than or equal to 1000 ppm: Supplied air respirator with full facepiece in positive-pressure mode.
Greater than 1000 ppm or Unknown concentration: (1) Self-contained breathing apparatus with full face-piece in positive pressure mode. (2) Full facepiece positive-pressure supplied-air respirator with auxiliary self-contained air supply.
Escape : (1) Any organic vapor gas mask; or (2) Any self-contained breathing apparatus with full facepiece.
Firefighting : Any full facepiece self-contained breathing apparatus operated in positive pressure mode.

'RTP51' LINE 1. [B28] Not enough string space - Out of Memory.

CHEMTOX DATA

IDENTIFIERS

CHEMTOX RECORD 421 LAST UPDATE OF THIS RECORD: 11/24/95

NAME: XYLENE

SYNONYMS: XYLENE (XYLOL); XYLOL; METHYL TOLUENE; BENZENE, DIMETHYL-; DIMETHYLBENZENE; NCI-C55232; VIOLET 3; XYLOL (DOT); SOCAL AQUATIC SOLVENT 3501

CAS: 1330-20-7 RTECS: ZE2100000

FORMULA: C8H10 MOL WT: 106.18

WLN: 1R X1

CHEMICAL CLASS: Aromatic hydrocarbon

See other identifiers listed below under Regulations.

PROPERTIES

PHYSICAL DESCRIPTION: colorless liquid with aromatic odor

BOILING POINT:	412 K	138.8 C	281.9 F
MELTING POINT:	247 K	-26.2 C	-15.1 F
FLASH POINT:	300.35-305.35 K	27.2-32.2 C	80.9-89.9 F
AUTO IGNITION:	736.45-802.05 K	463.3-528.9 C	866-984.1 F

VAPOR PRESSURE: 6.7 mm @ 21 C

UEL: 7 %

LEL: 1 %

IONIZATION POTENTIAL (eV): 8.56

VAPOR DENSITY: 3.7 (air=1)

EVAPORATION RATE: 0.77(n-BUTYL ACETATE=1)

SPECIFIC GRAVITY: 0.861 20C

DENSITY: 0.861 g/cc or 8.0073 lb/gal

WATER SOLUBILITY: VERY SL SOL

INCOMPATIBILITIES: strong oxidizers

REACTIVITY WITH WATER: No data on water reactivity

REACTIVITY WITH COMMON MATERIALS: No data

STABILITY DURING TRANSPORT: No Data

NEUTRALIZING AGENTS: No data

POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: None reported other than possible unburned vapors

ODOR DETECTED AT (ppm): 0.05

ODOR DESCRIPTION: LIKE BENZENE; CHARACTERISTIC AROMATIC
Source:CHRIS

100 % ODOR DETECTION: 0.4-20 ppm

REGULATIONS

DOT hazard class: 3 FLAMMABLE LIQUID

DOT guide: 27

Identification number: UN1307
DOT shipping name: XYLENES
Packing group: II
Label(s) required: FLAMMABLE LIQUID
Special provisions: T1
Packaging exceptions: 173.150
Non bulk packaging: 173.202
Bulk packaging: 173.242
Quantity limitations-
Passenger air/rail: 5 L
Cargo aircraft only: 60 L
Vessel stowage: B
Other stowage provisions:

STCC NUMBER: 4909350, 4909351

CLEAN WATER ACT Sect.307:No
CLEAN WATER ACT Sect.311:Yes
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 10 mg/L (07/30/92)
Maximum Contaminant Level Goals (MCLG): 10 mg/L (07/30/92)
CLEAN AIR ACT: CAA '90 Listed
EPA WASTE NUMBER: U239,D001
CERCLA REF: Not listed
RQ DESIGNATION: B 100 pounds (45.4 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312 categories:
Acute toxicity: Irritant
Acute toxicity: adverse effect to target organs.
Chronic toxicity: adverse effect to target organ after long period of exposure.
Chronic toxicity: reproductive toxin.
Fire hazard: flammable.
Chronic toxicity: carcinogen
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 1.0 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: Not given
Mailability: Nonmailable
Max per parcel: 0

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON ----------

ACGIH TLV list "Threshold Limit Values for 1992-1993"
California Assembly Bill 1803 Well Monitoring Chemicals.
Canadian Domestic Substances List
Clean Air Act Section 111 List.
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 311 Hazardous Chemicals List.
DOT Hazardous Materials Table. 49 CFR 172.101
EPA List of VOC chemicals from 40 CFR 60.489
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
Massachusetts Substance List.
New Jersey DEQ100 list for release reporting.
New Jersey Right To Know Substance List. (December 1987)
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
OSHA Process Safety Rule chemical with a TQ. Effective May 26, 1992
Pennsylvania Hazardous Substance List
RCRA Hazardous Constituents for Ground Water Monitoring. Ap'dx IX to 40 CFR 264
RCRA Hazardous Waste
SARA Section 110 Priority List of CERCLA Hazardous Substances
SARA Section 313 Toxic Chemicals List
Superfund/CERCLA RQ list. Table 302.4 in 54 FR 50968 (December 11, 1989)
Washington State Discarded Chemical Products List, November 17, 1989
Wisconsin Air Toxics Control Regulation NR-445 (December 1988)
XYLENE [1330-20-7]

---------- TOXICITY DATA ----------

SHORT TERM TOXICITY: Unknown

LONG TERM TOXICITY: unknown

TARGET ORGANS: CNS, eyes, gi tract, blood, liver, kidneys, skin

SYMPTOMS: DIZZ, EXCITEMENT, DROW, INCO, STAGGERING GAIT, IRRIT EYES, NOSE, THROAT, CORNEAL VACUOLIZATION, ANOREXIA, NAU, VOMIT, ABDOM PAIN; DERM Source: CHRIS

CONC IDLH: 1000ppm

NIOSH REL: 100 ppm Time weighted averages for 8-hour exposure 434 mg/M3 Time weighted averages for 8-hour exposure 200 ppm Ceiling exposures which shall at no time be exceeded(10-MIN) 868 mg/M3 Ceiling exposures which shall at no time be exceeded(10-MIN)

ACGIH TLV: TLV = 100ppm(434 mg/M3)

ACGIH STEL: STEL = 150 ppm(651 mg/M3)

OSHA PEL: Transitional Limits:
PEL = 100 ppm(435mg/M3)
Final Rule Limits:
TWA = 100 ppm (435 mg/M3)
STEL = 150 ppm(655 mg/M3)

MAK INFORMATION: 100 ppm
440 mG/M3
Substance with systemic effects, onset of effect less than or equal to 2 hrs: Peak = 2xMAK for 30 minutes, 4 times per shift of 8 hours.

CARCINOGEN?: N STATUS: See below

CARCINOGEN LISTS:
IARC: Not classified as to human carcinogenicity or probably not carcinogenic to humans.
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)
* orl-hmn LDLo:50 mg/kg YAKUD5 22,883,80

ihl-man LCLo:10000 ppm/6H BMJOAE 3,442,70
BEHAVIORAL
General anesthetic
LUNGS, THORAX, OR RESPIRATION
Cyanosis
BLOOD
Other changes

LD50 value: orl-rat LD50:4300 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:4300 mg/kg
ihl-rat LC50:5000 ppm/4H
ipr-rat LD50:2459 mg/kg
scu-rat LD50:1700 mg/kg
ipr-mus LD50:1548 mg/kg
ivn-rbt LDLo:129 mg/kg
ihl-gpg LCLo:450 ppm
ipr-gpg LDLo:2 gm/kg
ipr-mam LDLo:2 gm/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)

ihl-rat TCLo:250 mg/m3/24H (7-15D preg) ATSUDG 8,425,85
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:50 mg/m3/6H (1-21D preg) JHEMA2 27,337,83
EFFECTS ON FERTILITY
Post-implantation mortality
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Craniofacial(including nose and tongue)

ihl-rat TCLo:50 mg/m3/6H (1-21D preg) JHEMA2 27,337,83
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Other developmental abnormalities
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)

ihl-rat TCLo:600 mg/m3/24H (7-15D preg) PCBRD2 163B,295,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

orl-mus TDLo:20600 ug/kg (6-15D preg) JTEHD6 9,97,82
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Craniofacial(including nose and tongue)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

orl-mus TDLo:31 mg/kg (6-15D preg) JTEHD6 9,97,82
EFFECTS ON FERTILITY
Post-implantation mortality

ihl-mus TCLo:4000 ppm/6H (6-12D preg) TJADAB 28,22A,83
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)
EFFECTS ON NEWBORN
Physical

ihl-mus TCLo:2000 ppm/6H (6-12D preg) TJADAB 28,22A,83
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-mus TCLo:1 gm/m3/12H (6-15D preg) ATSUDG 8,425,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rbt TCLo:500 mg/m3/24H (7-20D preg) ATSUDG 8,425,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

California Prop 65: Not listed

---------- EPA's IRIS DATA SUMMARY ----------
Xylenes; CASRN 1330-20-7 (04/01/92)

_II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Xylenes
CASRN -- 1330-20-7
Last Revised -- 03/01/91

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quantitative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

__II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

___II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- D; not classifiable as to human carcinogenicity.

Basis -- Orally administered technical xylene mixtures did not result in significant increases in incidences in tumor responses in rats or mice of both sexes.

___II.A.2. HUMAN CARCINOGENICITY DATA

None.

II.A.3. ANIMAL CARCINOGENICITY DATA

Inadequate. In an NTP (1986) study, 50 male and 50 female F344/N rats were treated by gavage with mixed xylenes in corn oil (60% m-xylene, 14% p-xylene, 9% o-xylene and 17% ethylbenzene) at dosages of 0, 250 or 500 mg/kg/day, 5 days/week for 103 weeks. Similarly, 50 male and 50 female B6C3F1 mice were treated with the same xylene mixture at dosages of 0, 500 or 1000 mg/kg/day. Animals were killed and examined histologically when moribund or after 104-105 weeks. An apparent dose-related increased mortality was observed in male rats, but this difference was statistically significant for the high dose group, only. No other differences in survival between dosage groups of either sex were observed. Interstitial cell tumors of the testes could not be attributed to administration of the test compound observed in male rats (43/50 control, 38/50 low-dose and 41/49 high-dose). NTP (1986) reported that there were no significant changes in the incidence of neoplastic or nonneoplastic lesions in either the rats or mice that could be considered related to the mixed xylene treatment, and concluded that under the conditions of these 2-year gavage studies, there was "no evidence of carcinogenicity" of xylene (mixed) for rats or mice of either sex at any dosage tested.

Maltoni et al. (1985), in a limited study, reported higher incidences (compared with controls) of malignant tumors in male and female Sprague-Dawley rats treated by gavage with xylene in olive oil at 500 mg/kg/day, 4 or 5 days/week for 104 weeks. This study did not report survival rates or specific tumor types; therefore, the results cannot be interpreted.

Berenblum (1941) reported that "undiluted" xylene applied at weekly intervals produced one tumor-bearing animal out of 40 after 25 weeks in skin-painting experiments in mice. No control groups were described. Pound (1970) reported negative results in initiation-promotion experiments with xylene as the initiator and croton oil as the promotor.

II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

The frequency of sister chromatid exchanges and chromosomal aberrations were nearly identical between a group of 17 paint industry workers exposed to xylene and their respective referents (Haglund et al., 1980). In vitro, xylene caused no increase in the number of sister chromatid exchanges in human lymphocytes (Gerner-Smidt and Friedrich, 1978). Studies indicate that xylene isomers, technical grade xylene or mixed xylene are not mutagenic in tests with Salmonella typhimurium (Florin et al., 1980; NTP, 1986; Bos et al., 1981) nor in mutant reversion assays with Escherichia coli (McCarroll et al., 1981). Technical grade xylene, but not o- and m-xylene, was weakly mutagenic in Drosophila recessive lethal tests. Chromosomal aberrations were not increased in bone marrow cells of rats exposed to xylenes by inhalation (Donner et al., 1980).

__II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

Not available.

__II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

Not available.

__II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

___II.D.1. EPA DOCUMENTATION

U.S. EPA. 1987. Drinking Water Criteria Document for Xylene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Drinking Water, Washington, DC. ECAO-CIN-416. Final.

___II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The Drinking Water Criteria Document for Xylene has received Agency and external review.

Agency Work Group Review: 12/02/87

Verification Date: 12/02/87

___II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

Bruce Mintz / ODW -- (202)260-9569 / FTS 260-9569

W. Bruce Peirano / ORD -- (513)569-7540 / FTS 684-7540

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly when skin becomes contaminated.

** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammability

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
NIOSH (XYLENE)
1000 ppm: Any chemical cartridge respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any powered air-purifying respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any supplied-air respirator. * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus. * Substance reported to cause eye irritation or damage may require eye protection.
EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.: Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID SOURCE: NIOSH
EYE: irr immed
SKIN: soap wash promptly
INHALATION: art resp
INGESTION: no vomit

FIRST AID SOURCE: DOT Emergency Response Guide 1990.
Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with

running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

---------- INITIAL INCIDENT RESPONSE ----------

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: XYLENES
DOT ID NUMBER: UN1307

ERG93 GUIDE 27

POTENTIAL HAZARDS

*FIRE OR EXPLOSION
Flammable/combustible material; may be ignited by heat, sparks or flames.
Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.
Vapor explosion hazard indoors, outdoors or in sewers.
Runoff to sewer may create fire or explosion hazard.
Material may be transported hot.
*HEALTH HAZARDS
May be poisonous if inhaled or absorbed through skin.
Vapors may cause dizziness or suffocation.
Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind; keep out of low areas. Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection. *Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC AT 1-800-424-9300. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.
*SPILL OR LEAK
Shut off ignition sources; no flares, smoking or flames in hazard area. Stop leak if you can do it without risk. Water spray may reduce vapor; but it may not prevent ignition in closed spaces.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.
*FIRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

ATTACHMENT B
HEALTH AND SAFETY PLAN FORMS

PLAN ACCEPTANCE FORM

PROJECT HEALTH AND SAFETY PLAN

INSTRUCTIONS: This form is to be completed by each person working on the project site and returned to: EnSafe/Allen & Hoshall, Memphis, Tennessee.

Job No: 0106-071222

Contract No: N62467-89-D-0318

Project: SWMU 20 — 1594 Underground Waste Tank

I have read and understand the contents of the above plan and agree to perform my work in accordance with it.

_____

Signed

_____

Print Name

_____

Company

_____

Date

EMPLOYEE EXPOSURE HISTORY FORM

Employee:

Job Name: _____

Date(s) From/To: _____

Hours Onsite: _____

Contaminants (Suspected/Reported):

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(See Attached Laboratory Analysis)

PLAN FEEDBACK FORM

Problems with plan requirements:

Unexpected situations encountered:

Recommendations for revisions:

ACCIDENT REPORT FORM

SUPERVISOR'S REPORT OF ACCIDENT	DO NOT USE FOR MOTOR VEHICLE OR AIRCRAFT ACCIDENTS
TO	FROM TELEPHONE (Include area code)
NAME OF INJURED OR ILL WORKER AND COMPANY	
WORKER'S SOCIAL SECURITY NUMBER	

DATE OF ACCIDENT	TIME OF ACCIDENT	EXACT LOCATION OF ACCIDENT

NARRATIVE DESCRIPTION OF ACCIDENT

NATURE OF ILLNESS OR INJURY AND PART OF BODY INVOLVED	LOST TIME YES ☐ NO ☐

PROBABLE DISABILITY (Check one)

FATAL ☐ LOST WORKDAY WITH ____ DAYS AWAY FROM WORK

LOST WORKDAY WITH ____ DAYS OF RESTRICTED ACTIVITY

NO LOST WORKDAY ☐

FIRST-AID ONLY ☐

CORRECTIVE ACTION RECOMMENDED (By whom and by when)

NAME OF SUPERVISOR	TITLE
SIGNATURE	DATE

ATTACHMENT C

DIRECTIONS TO EMERGENCY MEDICAL FACILITIES

DIRECTIONS TO THE NEAREST MEDICAL FACILITIES

Methodist North Hospital is the nearest hospital **and** the nearest facility capable of treating chemical burns. Therefore, there is only one set of directions.

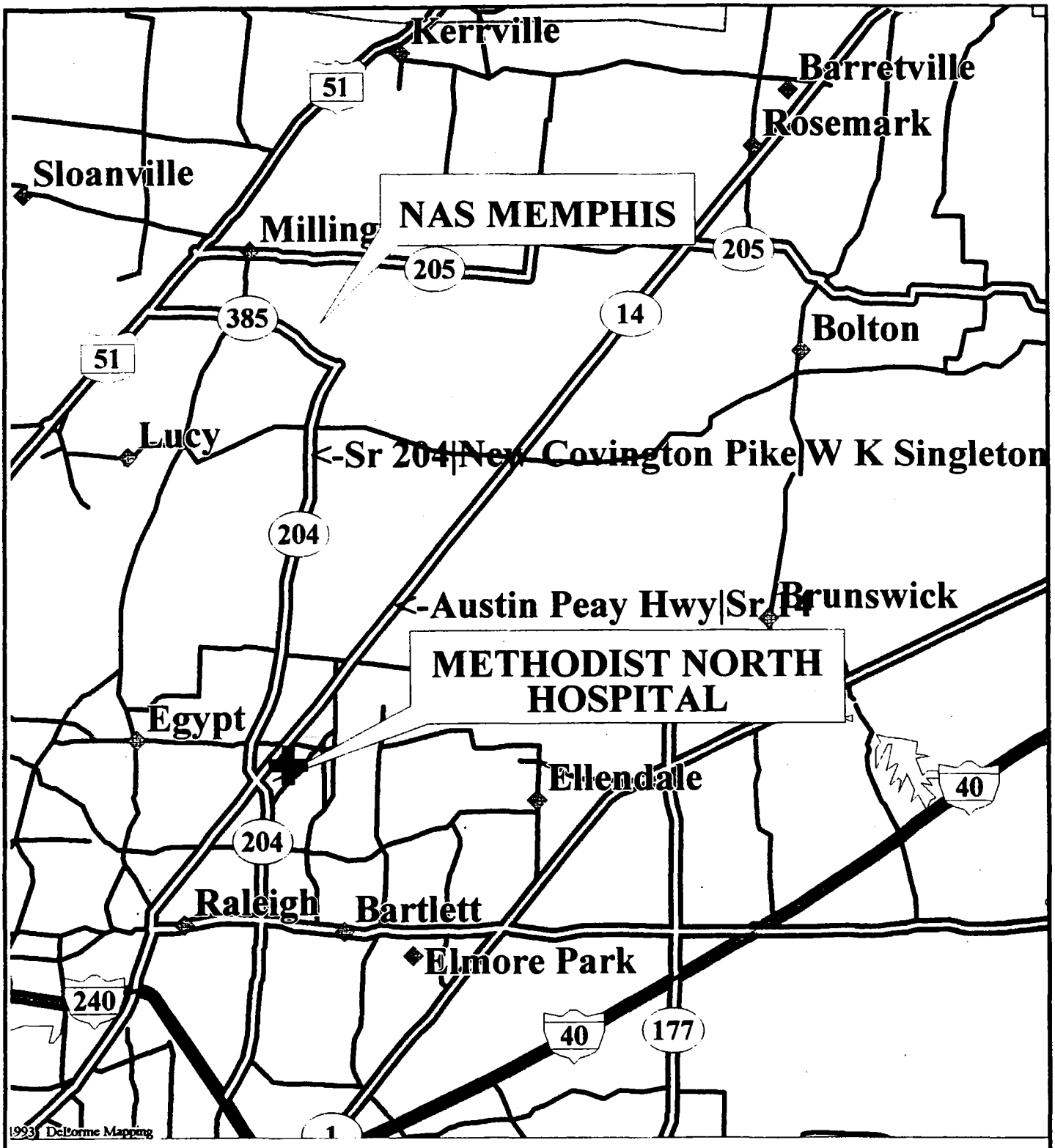
Nearest Hospital

Methodist North Hospital
3960 Covington Pike
Memphis, Tennessee

Emergency Room Telephone Number - (901) 372-5211

Directions to Methodist North Hospital from NSA Memphis Main Gate:

1) Exit site through South Gate (Singleton Parkway).
2) Continue on Singleton Parkway through the stop signs.
3) Singleton Parkway and Covington Pike will intersect at a red light (about 5 miles).
4) You will see the entrance to the emergency room 700 feet past this light on the left.



HEALTH & SAFETY PLAN NAS MEMPHIS MILLINGTON, TN	DIRECTIONS TO THE HOSPITAL	
	DWG DATE: 10/04/94	DWG NAME: BOARD

ASSEMBLY F — RFI WORK PLAN
NAVAL SUPPORT ACTIVITY MEMPHIS
MILLINGTON, TENNESSEE

SITE INVESTIGATION PLAN
SWMUs 22 and 63
S-75 UNDERGROUND STORAGE TANKS and
S-75N UNDERGROUND WASTE TANK

CTO-106
Contract Number: N62467-89-D-0318

Prepared for:

Department of the Navy
Southern Division
Naval Facilities Engineering Command
North Charleston, South Carolina

Prepared by:

EnSafe/Allen & Hoshall
5720 Summer Trees Drive, Suite 8
Memphis, Tennessee 38134
(901) 383-9115

April 4, 1996

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1.0 INTRODUCTION

As part of the U.S. Navy's Comprehensive Long-Term Environmental Action Navy program, the following Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Site Investigation Plan (SIP) has been prepared for a confirmatory sampling investigation at Solid Waste Management Unit (SWMU) 22, which is four underground storage tanks (USTs) adjacent to Building S-75, and SWMU 63, which is one underground waste tank (UWT) adjacent to Building S-75, at Naval Support Activity (NSA) Memphis, Millington, Tennessee. The primary references for this SIP are the *Comprehensive RFI Work Plan, Naval Air Station Memphis, Millington, Tennessee* (EnSafe/Allen & Hoshall, 1994) and the *RCRA Facility Assessment, NAS Memphis, Millington, Tennessee* (ERC/EDGe, 1990).

2.0 ENVIRONMENTAL SETTING

SWMU 22 is adjacent to the western side of Building S-75, the boiler plant, on the NSA Memphis Southside (Figure 1). The four USTs were installed in approximately 1944 and have since been removed, according to NSA Memphis personnel in the Public Works Office, Environmental Division. The diesel UST was removed in April 1992. SWMU 22 consisted of three fuel oil USTs for the boiler plant and one diesel fuel UST. USTs 1245 and 1246 each held 25,000 gallons, UST 1244 held 50,000 gallons, and the diesel UST held 280 gallons. The three large USTs were constructed of concrete with steel piping, while the diesel UST was steel. The information obtained on SWMU 22 during the 1990 RCRA Facility Assessment (RFA) is in Attachment 1 of this document, along with two drawings of tank systems around SWMU 22.

SWMU 63 is an approximately 7-foot x 7.5-foot area adjacent to Building S-75 on the NSA Memphis Southside (Figure 1). SWMU 63 formerly contained a 65-gallon, stainless-steel UWT. When the UWT was removed in April 1992, no surface contamination was evident. The surface area of SWMU 63 is indiscernible from the surface area of SWMU 22, so the investigation of the two SWMUs was combined in one work plan. The information obtained on SWMU 63 during the 1990 RFA is in Attachment 1 of this document.

Figure 1 Vicinity Map

2.1 Topography

SWMUs 22 and 63 and the surrounding area are characterized by relatively level, low-relief topography. The immediate area is covered by concrete or asphalt and surrounding areas have grass cover. Surface drainage is toward the west to a north-south oriented drainage ditch (SWMU 38) which flows into Big Creek Drainage Canal. A topographic map showing land surface elevations is provided in Attachment 2 of this document.

2.2 Geologic and Hydrogeologic Information

The regional and local hydrogeology are described in Sections 2.11 and 2.12, respectively, of the *Comprehensive RFI Work Plan*. Site-specific geologic and hydrogeologic information has been collected from the following sources:

- Several test holes completed on the NSA Memphis Southside, including two stratigraphic borings completed by the U.S. Geological Survey (USGS).

- Subsurface information obtained while installing two background well clusters, designated BG-02 and BG-04, on NSA Memphis Southside.

The following sections describe the geologic and hydrogeologic information for the NSA Memphis Southside.

2.2.1 Stratigraphic Test Borings

Test Hole Sh:U-89, approximately 450 feet northeast of SWMUs 22 and 63, was drilled and logged in 1983 to prepare for installing Southside production well PW-5 in 1985. The USGS completed two stratigraphic borings on the Southside, designated as Test Holes 7 and 8 (Figure 1), in 1995. Test Hole 7 is approximately 4,500 feet east of SWMUs 22 and 63. Test Hole 8 is approximately 6,000 feet southeast of SWMUs 22 and 63, at the southeast corner of the sewage lagoons (SWMU 9) near the Big Creek Drainage Canal. Table 1 describes the

lithology encountered in each stratigraphic test hole. As shown on Table 1, lithology in the upper interval of the test borings differs from north to south and west to east. Instead of loess and fluvial deposits, alluvium is present in the stratigraphic test boring nearest to Big Creek Drainage Canal (Test Hole 8). In addition, when comparing Test Hole Sh:U-89 to Test Holes 7 and 8, the fluvial deposits are thinner and the Cockfield Formation is thicker on the eastern part of the Southside. A copy of the boring log for Sh:U-89 is in Attachment 3 of this document.

Table 1
Test Borings on the NSA Memphis Southside

Stratigraphic Unit	Sh:U-89[a,b]	Test Hole 7 (Sh:V-79)	Test Hole 8 (Sh:V-80)
Alluvium	Not present	Not present	Clayey silt, 0-35 feet bls[c]; sand and gravel, 35-45 feet bls (45')[d]
	Silt and clay deposits, 0-38 feet bls (38')	Silt and clayey silt, 0-34 feet bls (34')	Not present
Fluvial Deposits	Sand and gravel, 38-97 feet bls (59')	Sand, gravel, and silt, 34-47 feet bls (13')	Not present
Cockfield Formation	Sand, silt, clay, and lignite, 97-134 feet bls (37')	Sand, clay, and lignite, 47-173 feet bls (126')	Sand, silty sand, clay, and lignite, 45-153 feet bls (108')
Cook Mountain Formation	Hard clay and silt, 134-160 feet bls (26'); confining unit for the Memphis Aquifer	Hard slightly silty clay, 173 feet bls to termination depth of boring at 202 feet; confining unit for the Memphis Aquifer	Hard slightly silty clay, 153 feet bls to termination depth of boring at 182 feet bls; confining unit for the Memphis Aquifer

Notes:
[a] — Sh:U-89 = USGS well designations
[b] — Lithologic description for Sh:U-89 based on driller's log contained in Attachment 3. Lithologic descriptions for Test Holes 7 and 8 are based on oral communication with USGS representatives; geophysical logs are forthcoming in USGS publications.
[c] — bls = below land surface
[d] — (38') indicates thickness of formation

The USGS collected soil samples from Test Holes 7 and 8 and submitted them for geotechnical analyses (J. Carmichael, USGS, written communication, 1995). Table 2 presents the hydraulic conductivity results for the soil samples.

Table 2
Hydraulic Conductivity Analyses: USGS Test Holes 7 and 8

Test Hole	Sample Depth (feet bls[a])	Vertical Hydraulic Conductivity (cm/sec)[b]
TH-7	10 - 12	2.83×10^{-7}
TH-7	160 - 162	1.04×10^{-7}
TH-7	200 - 201.5	3.48×10^{-7}
TH-8	17 - 19.5	2.41×10^{-6}
TH-8	180 - 182.5	1.76×10^{-9}

Notes:
[a] — bls = below land surface
[b] — Hydraulic conductivity determined using the following method: triaxial, constant head, undisturbed method; data reported in centimeters per second (cm/sec). Results obtained through written communication with Mr. Jack Carmichael of USGS.

2.2.2 Background Well Clusters 2 and 4

Two background well clusters, designated BG-02 and BG-04, were installed on the Southside in January 1995 in conjunction with the RFIs at Assembly A SWMUs. Figure 1 shows the background well locations and Attachment 3 contains the boring logs. Table 3 describes the lithology encountered at each background well location.

The lithology encountered at background well locations BG-02 and BG-04 was similar to that of stratigraphic test hole Sh:U-89 and Test Hole 7 described above; however, the fluvial deposits at BG-02 were thicker (38 feet) than at Test Hole 7 (13 feet).

Table 3
Background Wells on the NSA Memphis Southside

Stratigraphic Unit	BG-02	BG-04
Alluvium	Not present	Not present
Loess	Silt and clay deposits, 0-29 feet bls[a] (29')[b]	Silt and clayey silt, 0-38 feet bls (38')
Fluvial Deposits	Sand and gravel, 29-77 feet bls (48')	Sand, gravel, and silt, 38-71 feet bls (33')
Cockfield Formation	Sand, silt, and clay, 77 feet bls to termination depth of the boring at 87 feet bls	Sand and clay, 71 feet bls to termination depth of the boring at 76 feet bls

Notes:
[a] — bls = below land surface
[b] — (29') indicates thickness of formation

No groundwater monitoring wells exist at SWMUs 22 and 63. However, background monitoring well cluster BG-04 is approximately 900 feet southeast of SWMUs 22 and 63. The cluster consists of three monitoring wells, one each screened in the loess, upper fluvial deposits, and lower fluvial deposits. Groundwater measurements taken on March 30, 1995, indicate static groundwater levels in the wells are approximately 5 feet below land surface (bls) in the loess deposits, and 10 to 11 feet bls in the upper and lower fluvial deposits. Based on the topography and the information contained in the conceptual model of NSA Memphis hydrogeology (Section 2.12 of the *Comprehensive RFI Work Plan*), groundwater is presumed to flow southwesterly in the fluvial deposits. Within the NSA Memphis Southside, groundwater in the loess/shallow alluvium most likely moves primarily downward to recharge the fluvial deposits/deeper alluvium. In the immediate vicinity of SWMUs 22 and 63, some water in the loess may move laterally and discharge to the west to the SWMU 38 drainage ditch.

2.3 Climatological Data

Regional climatological data are provided in Section 2.8 of the *Comprehensive RFI Work Plan*.

3.0 SOURCE CHARACTERIZATION

The *Underground Storage Tank Closure Report, Tank No. S-75W* (National Salvage, 1992), contains information concerning the removal of the diesel UST at SWMU 22. When the diesel UST was removed, the excavated soil was stockpiled and sampled. Afterward, soil samples were collected from the four corners of the open tank pit and from the stockpiled soil. The tank pit soil samples were analyzed for total petroleum hydrocarbons-gasoline range organics (TPH-GRO) and TPH-diesel range organics (DRO), while the stockpiled soil was analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX); TPH-GRO and TPH-DRO; toxicity characteristic leaching procedure (TCLP) lead, benzene, and TPH and flash point. Results for the four tank pit samples had TPH-DRO concentrations of 5,187 parts per million (ppm) in the northwest corner, 5,008 ppm in the northeast corner, 11,259 ppm in the southeast corner, and 3,692 ppm in the southwest corner. The results for the stockpiled soil indicated a TPH-DRO concentration of 755 ppm and a TCLP TPH-DRO of 0.697 ppm. All other analytical parameters for the tank pit and stockpiled soil samples were below method detection limits. The flash point of the stockpiled soil was greater than 160°F.

Prior inspection reports for USTs 1244, 1245, and 1246 at SWMU 22 indicate they stored fuel oil and had no visible evidence of surface contamination or operational deficiencies.

The 65-gallon UWT at SWMU 63 was removed in April 1992 and had no visible evidence of surface contamination. Analysis of the contents removed from the 65-gallon UWT prior to the tank removal detected the following constituents and concentrations: methyl ethyl ketone at 22,000 ppm, acetone at 16,000 ppm, ethylbenzene at 20,000 ppm, toluene at 91,000 ppm, and xylenes at 110,000 ppm. Four soil samples collected from the SWMU 63 tank pit were analyzed for BTEX, TCLP metals, and TCLP volatiles. Analytical results for the soil samples were below the detection limit for all parameters tested, but the RFA noted a more comprehensive list of volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) should be analyzed to confirm whether hazardous constituents were present.

Field sampling will be performed as outlined in Section 4.3 of this SIP to determine whether contaminants are present. If contamination is verified, the scope of the investigation may be expanded to meet RFI requirements. Reference materials will be used to determine the physical, chemical, and migration/dispersal characteristics of any contaminants identified as exceeding appropriate action levels. The procedures and references used to determine these characteristics will be documented in an RFI report.

4.0 CHARACTERIZATION OF HAZARDOUS CONSTITUENT RELEASES

4.1 Previous Investigations

The data from the *Underground Storage Tank Closure Report, Tank No. S-75W*, indicate a release may have occurred prior to the diesel UST removal. No other investigations were available concerning SWMU 22. The data quoted in the RFA indicate a release at SWMU 63 was not found, but only limited investigation and analyses were performed. Prior inspection reports do not indicate any releases of hazardous constituents at SWMUs 22 or 63.

4.2 Data Gaps

The following data gaps will be the focus of this investigation:

- The potential for surface soil contamination associated with the USTs and UWT.
- The potential for subsurface soil contamination associated with the USTs and UWT.
- The potential for groundwater contamination associated with the USTs and UWT.

Concentrations of contaminants identified in soil and groundwater at SWMUs 22 and 63 will be compared to background soil and groundwater concentrations as determined from the five background monitoring wells installed across NSA Memphis in 1995 and from eight additional background monitoring wells installed in 1996 to determine whether measured values occur naturally or indicate contamination. Soil and groundwater samples collected from the original

background monitoring wells were analyzed for full scan analysis (FSA) using the following methods:

- VOCs, U.S. Environmental Protection Agency (USEPA) Method 8240
- SVOCs, USEPA Method 8270
- TPH, USEPA Method 418.1
- TPH-GRO, Tennessee (TN) Modified 8015/GRO
- TPH-DRO, TN Modified 8015/DRO
- Chlorinated pesticides/polychlorinated biphenyls (PCBs), USEPA Method 8080
- Organophosphorus pesticides, USEPA Method 8140
- Chlorinated herbicides, USEPA Method 8150
- RCRA Part 264, Appendix IX Total Metals, USEPA Method 6010/7000 series
- Total cyanide, USEPA Method 9010

Surface soil and groundwater samples from the recently installed (1996) monitoring wells will be analyzed for Appendix IX metals.

4.3 Objective of Proposed Field Investigation

The objective of the proposed field investigation is to fill the data gaps identified in Section 4.2. All samples will be collected and processed in accordance with Section 4 of the *Comprehensive RFI Work Plan*. If contamination is identified at SWMUs 22 and 63, the Base Realignment and Closure Cleanup Team (BCT) will review the sampling results to determine whether a second round of investigation, to include soil borings and/or monitoring wells, will be necessary.

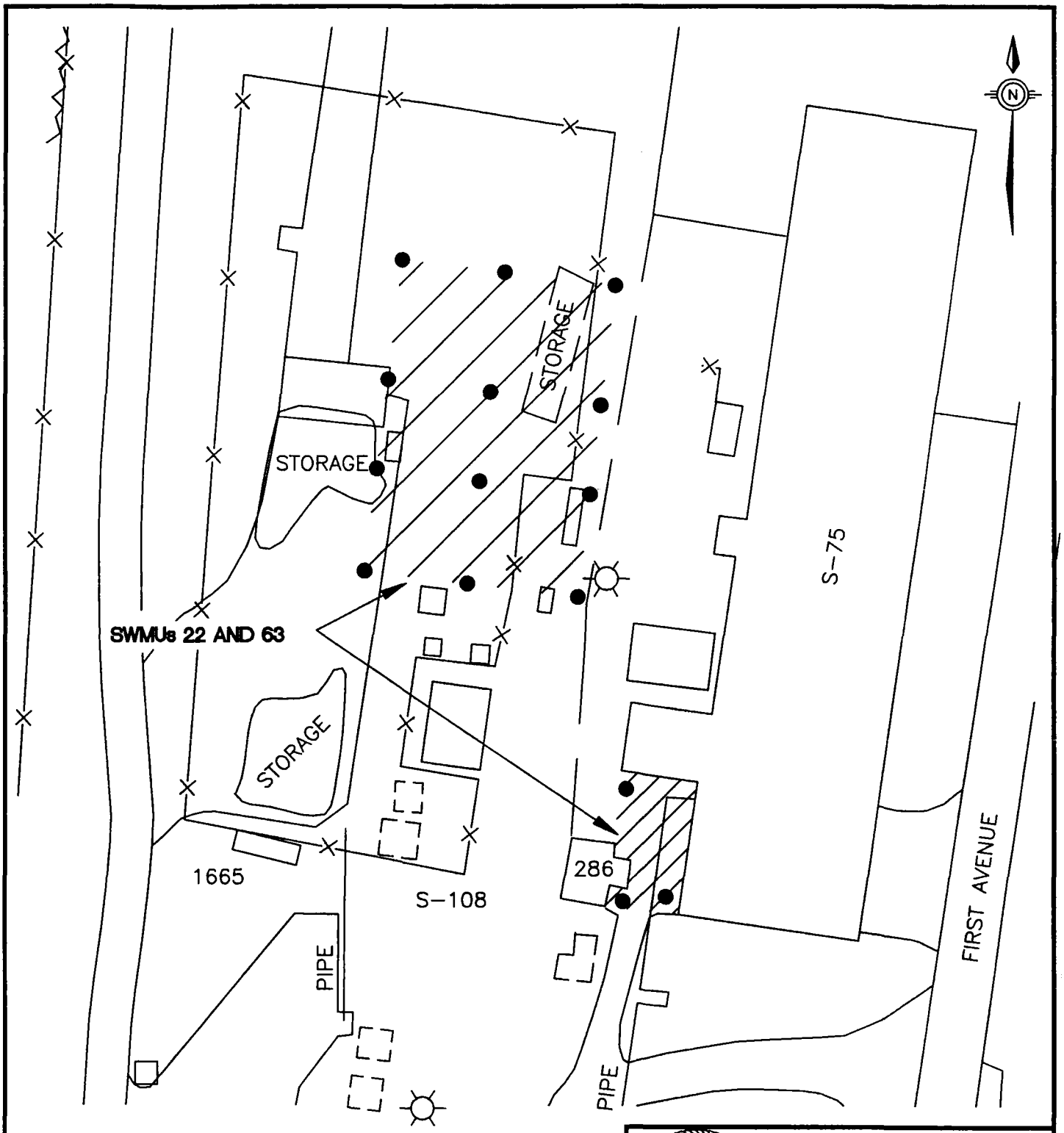
Field personnel may deviate from the strategy outlined below if field conditions or data (i.e., visual observations or field screening results) suggest additional or different intervals may be successfully sampled or yield more useful information. Any deviations will be documented in the field logbook and the SIP report. The investigatory area may then be expanded or concentrated, based on the results of the initial data.

4.3.1 Soil

The proposed soil investigation will consist of hand auger and Geoprobe sampling (as outlined in Section 4.4.4.3 of the *Comprehensive RFI Work Plan*) for field and/or laboratory analysis. Fifteen sampling locations have been selected as shown in Figure 2. Twelve sample locations were selected on a grid covering the former location of USTs 1244, 1245, and 1246. Three sample locations were selected in the area of the diesel UST and 65-gallon UWT. Soil samples will be collected from the surface to 1 foot deep (upper interval) using a hand auger and at a depth equivalent to the bottom of the respective USTs using a hand auger or the Geoprobe (lower interval). The upper interval samples will be sent to an offsite laboratory for FSA using methods outlined in Section 4.2. The lower interval samples will be analyzed in the field with a portable gas chromatograph/mass spectrometer (GC/MS) for VOCs (USEPA Method 8240). At least 25% of the soil samples analyzed onsite will be split for confirmatory VOC analysis (USEPA Method 8240) by an offsite laboratory.

4.3.2 Groundwater

The proposed groundwater investigation will consist of Geoprobe sampling (as outlined in Section 4.4.4.3 of the *Comprehensive RFI Work Plan*) for field and/or laboratory analysis. Based on previous work conducted at other SWMUs, the Geoprobe is anticipated to be able to penetrate through the loess and into the fluvial deposits to a refusal depth greater than 50 feet bls. Groundwater samples will be collected at all 15 Geoprobe locations within SWMUs 22 and 63, as dictated by field conditions (i.e., buried steam lines around the boiler plant may make it impossible to collect samples at some locations). Groundwater samples will be obtained from the first water-bearing zone in the loess and from the fluvial deposits, if possible. The groundwater samples will be analyzed in the field with a GC/MS for VOCs (USEPA Method 8240). At least 25% of the groundwater samples analyzed onsite will be split for confirmatory VOC analysis (USEPA Method 8240) by an offsite laboratory.



LEGEND

● SAMPLING POINTS

SWMUs 22 & 63

50 0 50

SCALE FEET

RFI WORK PLAN
NSA MEMPHIS
MILLINGTON, TENNESSEE

FIGURE 2
SWMUs 22 AND 63–SAMPLING POINTS

DWG DATE: 03/29/96 | DWG NAME: 94SP2263

4.3.3 Soil Boring/Monitoring Well Phase

After the BCT reviews the analytical data from the first phase of the investigation, a second phase, consisting of installing and sampling soil borings and monitoring wells, may be implemented. The number, locations, and depths of soil borings and/or monitoring wells will be determined using data from the first phase of this investigation. An addendum to this plan describing the proposed drilling, sampling, and analytical strategies for an expanded investigation will be prepared and submitted to the BCT for review and comment, should a second phase be required.

4.3.4 Analytical Requirements

Soil and groundwater samples analyzed in the field with a portable GC/MS will adhere to Level II-equivalent Data Quality Objectives (DQOs). Samples submitted to an offsite laboratory will adhere to Level III-equivalent DQO for 95% of the samples and Level IV-equivalent DQO for the remaining 5%. Field personnel will determine which samples will receive Level IV DQO. Table 4 shows the tentative number of samples to be collected and the analyses to be performed.

Table 4
Proposed Sampling and Analytical Requirements — SWMUs 22 and 63

Method	Sample Matrix/Type	Number of Samples	Analysis
Hand Auger	Soil — upper interval	15	FSA[a]
Hand Auger or Geoprobe	Soil — lower interval	15	VOC[b]
Geoprobe	Groundwater	15 (loess) 15 (fluvial deposits)	VOC[b] VOC[b]

Notes:

[a] — FSA (Full Scan Analysis) to include VOC, SVOC, TPH (418.1), TPH-GRO, TPH-DRO, chlorinated pesticides/PCBs, organophosphorus pesticides; chlorinated herbicides, total metals (Appendix IX), and cyanide.

[b] — VOC analysis to be performed in the field with a GC/MS. At least 25% of the total number of samples will be split and submitted to an offsite laboratory for confirmatory VOC analysis.

4.4 Sample Management

Sample management procedures will adhere to Sections 4.12 and 5 of the *Comprehensive RFI Work Plan.*

4.5 Sample Custody

Sample custody procedures will adhere to Section 4.12.5 of the *Comprehensive RFI Work Plan.*

4.6 Quality Assurance/Quality Control

Quality assurance/quality control procedures to be followed during this investigation will adhere to Section 4.14 of the *Comprehensive RFI Work Plan.*

4.7 Decontamination Procedures

Decontamination procedures will adhere to Section 4.11 of the *Comprehensive RFI Work Plan.*

4.8 Investigation-Derived Waste

Investigation-derived waste will be handled as specified in Section 4.13 of the *Comprehensive RFI Work Plan.*

5.0 POTENTIAL RECEPTORS

SWMUs 22 and 63 are approximately 300 feet east of the nearest offsite residence and 20 feet west of the nearest NSA Memphis office personnel at Building S-75. Storm water from SWMUs 22 and 63 discharges into SWMU 38, which in turn discharges into the Big Creek Drainage Canal approximately 2,200 feet south of SWMUs 22 and 63. Big Creek Drainage Canal may serve as a food and water source for various animals. SWMU 38 comprises drainage ways in populated areas of NSA Memphis; therefore, the potential exists for infrequent contact with surface water and sediment in these ditches by NSA Memphis personnel. Offsite, the potential exists for contact with surface water and sediment by the general public due to

unrestricted access to the Big Creek Drainage Canal. According to NSA Memphis personnel, no fishing or swimming occurs in Big Creek Drainage Canal, but children may play near it.

Other potential receptors include two production wells shown in Figure 1, PW-4 and PW-5. SWMUs 22 and 63 are approximately 1,800 feet south of PW-4 and approximately 400 feet south of PW-5. Both production wells are screened in the Fort Pillow Aquifer (PW-4 is screened at 1,450 feet bls and PW-5 is screened at 1,435 feet bls), with the Flour Island confining unit above the screened intervals.

The potential for ecological and human health effects will be analyzed in detail if contamination is identified at SWMUs 22 and 63.

6.0 QUALITY ASSURANCE PLAN

The Quality Assurance Plan presented in Section 4.14 of the *Comprehensive RFI Work Plan* will be followed throughout this investigation at SWMUs 22 and 63.

7.0 DATA MANAGEMENT PLAN

The Data Management Plan presented in Section 5 of the *Comprehensive RFI Work Plan* will be followed during this investigation at SWMUs 22 and 63.

8.0 HEALTH AND SAFETY PLAN

The Site-Specific Health and Safety Plan for SWMUs 22 and 63 is included as Appendix A. The Comprehensive Health and Safety Plan is included in Section 7 of the *Comprehensive RFI Work Plan*.

9.0 REFERENCES

EnSafe/Allen & Hoshall (October 1994). *Comprehensive RFI Work Plan for Naval Air Station Memphis*. EnSafe/Allen & Hoshall: Memphis, Tennessee.

ERC/EDGe (September 1990). *RCRA Facility Assessment, NAS Memphis*. ERC/EDGe: Nashville, Tennessee.

National Salvage & Service Corporation (July 1992). *Underground Storage Tank Closure Report, Tank No. S-75W*. National Salvage & Service Corp.: Bloomington, Indiana.

Southern Division Naval Facilities Engineering Command (May 1990). *Draft Final RCRA Facility Investigation Work Plan for Naval Air Station-Memphis*. SOUTHDIV: Charleston, South Carolina.

Appendix A
Site-Specific Health and Safety Plan

ASSEMBLY F — RFI WORK PLAN
NAVAL SUPPORT ACTIVITY MEMPHIS
MILLINGTON, TENNESSEE

SITE-SPECIFIC HEALTH AND SAFETY PLAN
SWMUs 22 and 63
S-75 UNDERGROUND STORAGE TANKS and
S-75N UNDERGROUND WASTE TANK

CTO-106
Contract Number: N62467-89-D-0318

Prepared for:

Department of the Navy
Southern Division
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North Charleston, South Carolina

Prepared by:

EnSafe/Allen & Hoshall
5720 Summer Trees Drive, Suite 8
Memphis, Tennessee 38134
(901) 383-9115

April 4, 1996

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1.0 INTRODUCTION

A Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) is being conducted at Solid Waste Management Unit (SWMU) 22, which includes four underground storage tanks (USTs) adjacent to Building S-75, and SWMU 63, which includes one underground waste tank (UWT) adjacent to Building S-75, at the Naval Support Activity (NSA) Memphis, Millington, Tennessee, to assess the nature and extent of potential contamination onsite and to determine if additional action is required to maintain compliance with environmental regulations.

This Site-Specific Health and Safety Plan (SSHSP) is written for field operations to be conducted at SWMUs 22 and 63. This plan is to be used in conjunction with the approved NSA Memphis Comprehensive Health and Safety Plan (CHASP). Copies of both this plan and the CHASP should be onsite during all field operations.

Applicability

See CHASP Section 7.

Current Hazardous Waste Operations and Emergency Response (HAZWOPER) training certificates for EnSafe/Allen & Hoshall (E/A&H) personnel and all subcontractors anticipated to be conducting fieldwork will be filed onsite and available for review. Individuals whose certifications are not on file, or those who have more recent certificates (have attended refresher courses), will provide the Site Supervisor with copies of their certificates before being allowed to enter a work area.

Current Occupational Safety and Health Administration (OSHA) refresher training certificates will be available onsite for all employees involved in field activities if their refresher course requirements come up for renewal before the project begins. All subcontractors, Navy oversight personnel, and any other site visitors must provide health and safety certification with appropriate refresher course documentation prior to site entry.

2.0 SITE CHARACTERIZATION

2.1 Site Description

SWMU 22 is adjacent to the western side of Building S-75, the boiler plant, on the NSA Memphis Southside. It contains three USTs which store fuel oil for the boiler plant and one UST which stores diesel fuel (Figure 1). USTs 1245 and 1246 are 25,000 gallons, UST 1244 is 50,000 gallons, and the diesel fuel UST is 280 gallons in capacity. The three large USTs are constructed of concrete and steel piping while the diesel UST is constructed of steel. All four USTs have been removed, according to NSA Memphis personnel.

SWMU 63 is an approximately 7-foot x 7.5-foot area adjacent to Building S-75 on the NSA Memphis Southside. It formerly contained a 65-gallon stainless steel UWT (Figure 1). The UWT was removed in April 1992.

2.2 Work Areas

See Section 7.1.1 of the CHASP for a description of the following work zones:

- Exclusion Zone (EZ)
- Contaminant Reduction Zone (CRZ)
- Support Zone (SZ)

Field activities to be conducted onsite and within each work area are described in the Site Investigation Plan.

2.3 Work Area Access

Authorized personnel will be allowed access to work areas as long as they have presented documentation of 40-hour OSHA training under Title 29 Code of Federal Regulations (CFR) Part 1910.120, have signed CHASP and SSHSP plan acceptance forms, and have received a

Figure 1 Vicinity Map

hazard communication briefing from the site health and safety officer or site manager. See also Work Area Access, Section 7.1.2 of the CHASP.

2.4 Site Map and Work Zones

Sampling locations at the site are shown in Figure 2. The EZ, CRZ, and SZ locations will be based on physical layout of the site, work task requirements, and current meteorological conditions. When non-investigation personnel are in the vicinity the EZ will be established using yellow caution tape. Figure 3 shows a typical site work zone setup.

3.0 SITE ACTIVITIES

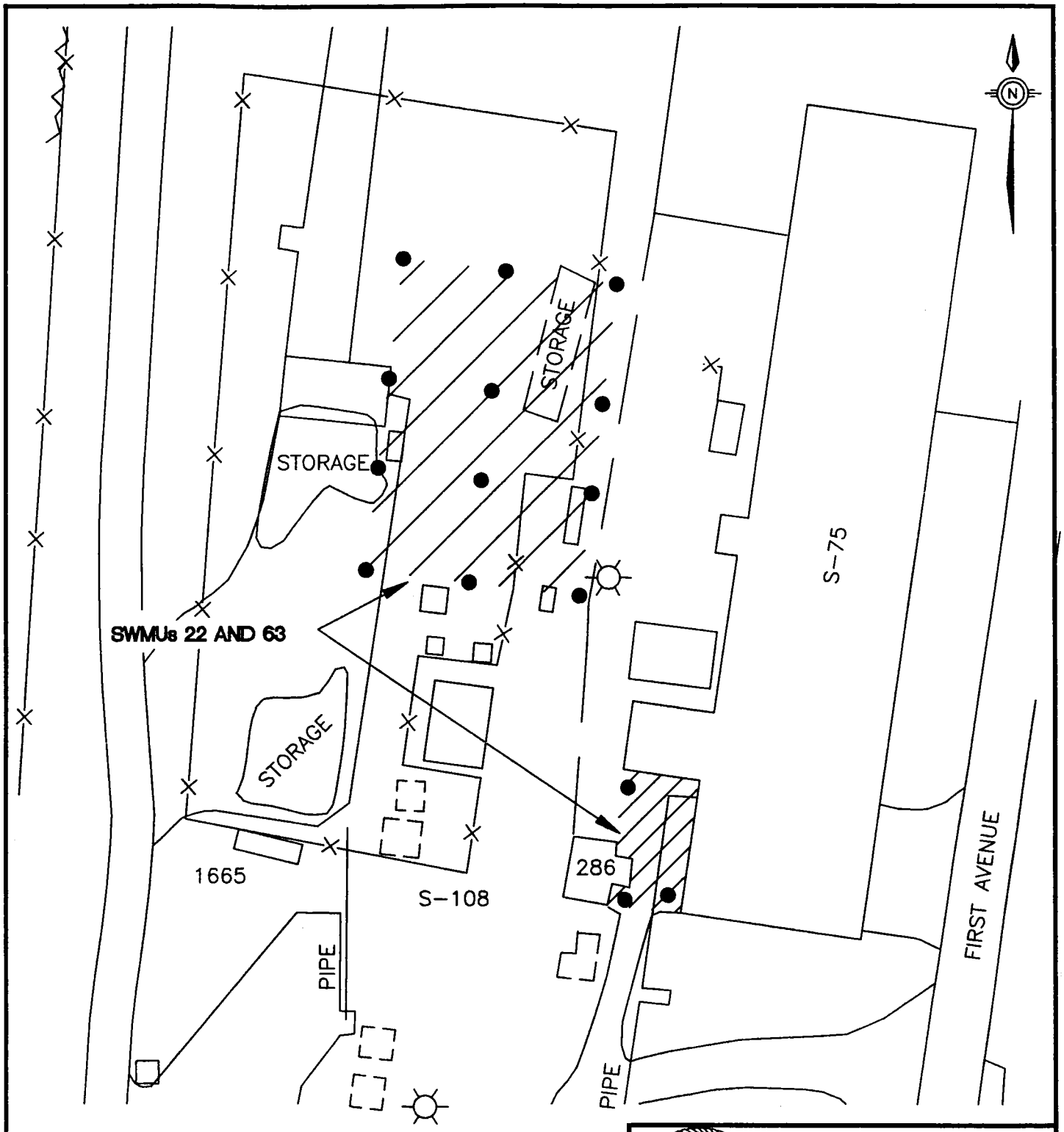
Site activities will include Geoprobe and hand auger soil and groundwater sampling. Field methods are described in the *Comprehensive RFI Work Plan, Naval Air Station Memphis, Millington, Tennessee* (E/A&H, 1994).

4.0 CHEMICAL HAZARDS

The site history suggests a potential for exposure to chemicals. Table 4-1 lists exposure guidelines for potential site chemicals. Material Safety Data Sheets (MSDSs) for those chemicals are include in Attachment A.

5.0 OPERATIONS AND PHYSICAL HAZARDS

Physical hazards typically encountered during environmental investigations will be present onsite. These hazards include cold or heat-related illnesses, uneven terrain, slippery surfaces, lifting, and use of heavy equipment. The Site Supervisor and Site Health and Safety Officer shall be aware of the potential for heat and/or cold stress and other weather-related illnesses and, as necessary, implement appropriate work regimens to minimize the likelihood of field personnel becoming ill or injured.



LEGEND

● SAMPLING POINTS

SWMUs 22 & 63

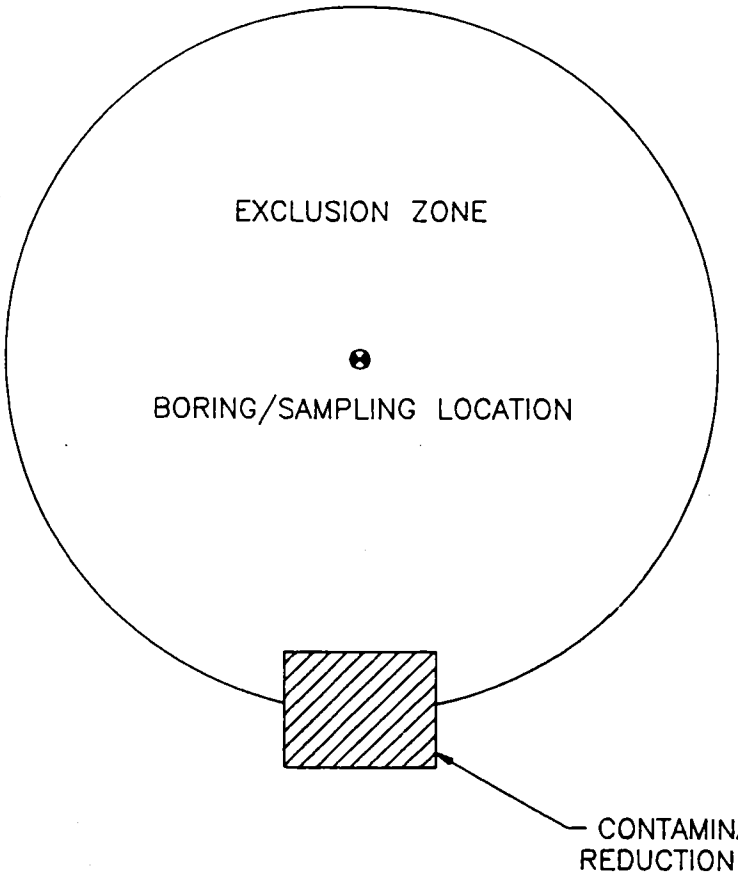
50 0 50

SCALE FEET

RFI WORK PLAN
NSA MEMPHIS
MILLINGTON, TENNESSEE

FIGURE 2
SWMUs 22 AND 63–SAMPLING POINTS

DWG DATE: 03/29/96 | DWG NAME: 94SP2263



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RFI WORK PLAN
NSA MEMPHIS
MILLINGTON, TENNESSEE

FIGURE 3
SITE WORK ZONES

DWG DATE: 09/12/95 | DWG NAME: 094SWZ01

Heavy equipment operations will be conducted in accordance with the procedures outlined in the CHASP, Attachment A, Drilling Safety Guide. When conducting operations or survey work on foot, personnel will walk at all times. Running greatly increases the probability of slipping, tripping, and falling. If working in areas supporting habitat for poisonous snakes, personnel should wear protective chaps made of a heavy material designed to prevent snake bites to the legs.

Table 4-1
Exposure Guidelines For Expected Site Chemical Hazards

Chemical Name	Odor[a] Threshold (ppm)	OSHA PEL[b] (ppm)	ACGIH TLV[c] (ppm)	NIOSH REL[d] (ppm)	Action Level[e] (ppm)	Flammable Range (% by Volume)
Toluene	40	100 150 STEL	50	100 150 STEL	25	1.3 to 7.1%
Lead	N.A.	0.05 mg/m³	0.15 mg/m³	<0.1 mg/m³	0.025 mg/m³	N.A.
Diesel Fuel	N.A.	N.A.	N.A.	N.A.	N.A.	0.7 to 7.5%
Ethylbenzene	140	100 125 STEL	100 125 STEL	N.A.	50	1.0 to 6.7%
Benzene	4.68	1 5 STEL	0.1 Confirmed Human Carcinogen	0.1 1 STEL Potential Occupational Carcinogen	0.05	1.3 to 7.1%
Xylene	Not Listed	100 150 STEL	100 150 STEL	100 150 STEL	50	1.0 to 7.0%

Notes:
[a] — Odor Thresholds for Chemicals with Established Occupational Health Standards, American Industrial Hygiene Association, 1989, Range of All Reference Values.
[b] — 29 CFR 1910.1000, Table Z-1-A. Limits for Air Contaminants, as amended through 1/15/91. (PEL = Permissible Exposure Limit)
[c] 1990-1991 Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices, American Conference for Governmental Industrial Hygienists (ACGIH). (STEL = Short-Term Exposure Limit)
[d] — National Institute for Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards, June 1990. (REL = Recommended Exposure Limit)
[e] — Action Level is the exposure limit at which personnel will implement engineering controls or upgrade levels of personal protective equipment. The Action Level is based on 50% of the PEL, TLV, or REL, whichever is lower.
mg/m³ = milligrams per cubic meter
ppm = parts per million
N.A. — Substance information not available, or substance unlisted.

6.0 EMPLOYEE PROTECTION

Employee protection for this project includes standard safe work practices, NSA Memphis rules of conduct, personal protective equipment (PPE), personal decontamination procedures, and equipment for extreme weather conditions, work limitations, and exposure evaluation.

6.1 Standard Safe Work Practices

- Eating, drinking, chewing gum or tobacco, smoking, or any activity that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated as contaminated.

- Hands and face must be thoroughly washed upon leaving the work area.

- No contact lenses will be worn in work areas while invasive actions are conducted.

- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.

- Contact with contaminated or suspected contaminated surfaces should be avoided. Whenever possible, do not walk through puddles, leachate, or discolored surfaces, or lean, sit, or place equipment on drums, containers, or soil suspected of being contaminated.

- Medicine and alcohol can exacerbate the effects from exposure to toxic chemicals. Prescribed drugs should not be taken by personnel on cleanup or response operations where the potential for absorption, inhalation, or ingestion of toxic substances exists unless specifically approved by a qualified physician. Consumption of alcoholic beverages is prohibited.

- Due to the possible presence of overhead power lines, adequate side and overhead clearance should be maintained to ensure that the drill rig boom does not come within 15 feet of any overhead lines.

- Due to the possible presence of underground utilities (including electric, natural gas, water, sewer, telephone, etc.), the activity and local utility representatives should be contacted and requested to identify all lines at the ground surface using characteristic spray paint or labeled stakes. A 3-yard buffer zone should be maintained during all subsurface investigations.

- Due to the flammable properties of the potential chemical hazards, all spark or ignition sources should be bonded and/or grounded or mitigated before soil boring advancement or other site activities begin.

6.2 NSA Memphis General Rules of Conduct

- Liquor, firearms, narcotics, tape recorders, and other contraband items are not permitted on the premises.

- Any violation of local, state, or federal laws, or conduct which is outside the generally accepted moral standards of the community is prohibited.

- Violation of the Espionage Act, willfully hindering or limiting production, or sabotage is not permitted.

- Willfully damaging or destroying property, or removing government records is forbidden.

- Misappropriation or unauthorized alteration of any government records is forbidden.

- Securing government tools in a personal or contractor's tool box is forbidden.

- Gambling in any form, selling tickets or articles, taking orders, soliciting subscriptions, taking up collections, etc. is forbidden.

- Doing personal work in government shop or office, using government property or material for unauthorized purposes, or using government telephones for unnecessary or unauthorized local or long-distance telephone calls is forbidden.

- Compliance with posted signs and notices is required.

- Boisterousness and noisy or offensive work habits, abusive language, or any oral, written, symbolic, or other communicative expression which tends to disrupt the work or morale of others is forbidden.

- Fighting or threatening bodily harm to another is forbidden.

- Defacing any government property is forbidden.

- Wearing shorts of any type and/or offensive logos, pictures, or phrases on clothing is forbidden. Shirts, shoes, and pants, slacks, or coverall-type garments will be worn at all times on government property.

- All persons operating motor vehicles will obey all NSA Memphis traffic regulations.

6.3 Selection of Personal Protective Equipment

It is important that PPE be appropriate to protect against the potential or known hazards at each cleanup or investigation site. Protective equipment will be selected based on the types,

concentrations, and routes of personal exposure that may be encountered. In situations where the types of materials and possibilities of contact are unknown or the hazards are not clearly identifiable, a more subjective determination must be made of the PPE required, based on experience and sound safety practices.

The Project Health and Safety Officer will determine the appropriate level of PPE prior to the initial entry based on the chemical(s) of concern, air monitoring levels (i.e., photoionization detector [PID] readings, combustible gas indicator [CGI] readings, or colorimetric tube results), or physical site conditions (i.e., heat stress or cold exposure). PPE requirements are subject to change as site information is updated or changes. **The decision to upgrade or downgrade levels of PPE shall be made by the Project Health and Safety Officer.**

Field activities which disturb soil will be initiated in modified Level D protection except when stated otherwise in the SSHSP or when site conditions (e.g., sampling results from previous studies) indicate that modified Level D is inappropriate. Modified Level D protection consists of a hard hat, appropriate chemical-resistant gloves (vinyl or nitrile), eye protection, and chemical-resistant, steel toe and shank boots. Work coveralls (full length sleeves and pants) will be worn if free product or contaminants identified as skin irritants are encountered. This level of protection was selected because the contaminant concentrations detected in previous studies were low and free product was not detected.

PPE upgrades to Level C will be initiated if airborne concentrations exceed 2 parts per million (ppm) above the background concentration in the breathing zone or if the concentration of any contaminant exceeds 50% of the OSHA Permissible Exposure Limit (PEL). See Table 6-1 for the specific criteria for use and equipment for each level of protection.

6.4 Air Monitoring

Site history and previous site work indicate workers may be exposed to low concentrations of numerous chemicals including volatile organic compounds (VOCs), halogenated compounds, and combustible gases/vapors. Based on site history and current sampling data, "worst-case" contaminated areas will be identified before field activities begin.

Air will be monitored using a PID and/or other appropriate sampling equipment prior to beginning field activities at a new EZ and during ground-disturbing activities. The PID will be field calibrated to measure VOCs relative to a 100 ppm isobutylene standard. If VOCs are detected downhole, colorimetric detector tubes and/or other sampling media may be used to identify and approximate the concentrations of these compounds.

A CGI will be used during all soil borings and well installation activities. The CGI will be field calibrated to measure flammable gases relative to a 23% lower explosive limit (LEL) methane standard. Downhole CGI readings will be collected continuously whenever soil is disturbed.

Table 6-1
Level Of Protection And Criteria

	Criteria for Use	Equipment
Level A	• When atmospheres are "immediately dangerous to life and health" (IDLH in the NIOSH/OSHA Pocket Guide to Chemical Hazards or other guides). • When known atmospheres or potential situations exist that would affect the skin or eyes or be absorbed into the body through these surfaces. Consult standard references to obtain concentrations hazardous to skin, eyes, or mucous membranes. • Potential situations include those where immersion may occur, vapors may be generated, or splashing may occur through site activities. • Where atmospheres are oxygen deficient with the conditions above. • When the type(s) and or potential concentration of toxic substances are not known.	• Positive pressure-demand full facepiece, self-contained breathing apparatus (SCBA) or positive pressure-demand supplied air respirator with escape SCBA • Totally encapsulating chemical protective suit • Chemical-resistant inner and outer gloves • Steel toe and shank chemical-resistant boots • Hard hat under suit • Two-way radios worn inside suit • Coveralls, long cotton underwear, disposable protective suit, gloves and boots, worn over fully encapsulating suit
Level B	• When work areas contain less than 19.5% oxygen. • When vinyl chloride is detected in the breathing zone.	• Chemical resistant clothes, long sleeves, hooded, one or two pieces • Full-faced positive-pressure demand supplied air breathing apparatus or airline system with a 30-minute escape bottle • Hard hat • Inner gloves and chemical-resistant gloves • Steel toe and shank boots • Coveralls and disposable outer boots
Level C	• When airborne dust particles warrant respiratory protection. • When work areas contain at least 19.5%t oxygen.	• Chemical-resistant clothes, long sleeves, hood optional, one or two pieces • Full-face piece, air purifying respirator equipped with cartridges suitable for the hazard • Hard hat • Inner gloves and chemical-resistant gloves • Steel toe and shank boots • Coveralls and disposable outer boots

Table 6-1
Level Of Protection And Criteria

	Criteria for Use	Equipment
Level D	• When level B or C is not indicated. • When airborne particles do not warrant respiratory protection. • When work areas contain at least 19.5% oxygen.	• Inner gloves and chemical-resistant gloves needed to handle soil or water samples • Steel toe and shank boots • Hard hat (ANSI Z891-1969 standard) • Eye protection (ANSI Z87.1-1968) standard • Sunscreen (SPF 15 or greater) • Coveralls and disposable outer boots

Notes:
ANSI = American National Standards Institute.
Level A protection will be selected when the highest available level of respiratory, skin, and eye protection is needed. Level A protection will be required in Area A of the exclusion zone.

Contraindications for use of Level A:
- Environmental measurements contiguous to the site indicate that air contaminants do not represent a serious dermal hazard.
- Reliable, accurate historical data do not indicate the presence of severe dermal hazards.
- Open, unconfined areas.
- Minimal probability of vapors or liquids (splash hazards) present which could affect or be absorbed through the skin.
- Total vapor readings indicate 500 ppm to 1,000 ppm.

Level B protection will be selected when the highest level of respiratory protection is needed, but cutaneous exposure to the small unprotected areas of the body (neck and back of head) is unlikely, or where concentrations are not known to be within acceptable standards. Additionally, the permissible limit for exposure to mixtures of all site gases will be checked using the requirements of 1910.1000(d)(2)(i) to ensure that PEL is not exceeded. If the value calculated using this method exceeds 1.0, Level B PPE is required.

Level C protection will be selected when the types and concentrations of inseparable material are known, or reasonably assumed to be no greater than the protection factors associated with air-purifying respirators, and exposure to unprotected areas of the body is unlikely to cause harm. Dust concentrations require Level C PPE, where the respirable fractions exceed the PEL of 5 milligrams per cubic meter (mg/m^3) or the total concentrations exceed the PEL of 15 mg/m^3.

Level D protection will be chosen when measurements of atmospheric concentrations are at background levels and work functions preclude splashes, immersion, or the potential for unexpected inhalation or contact with hazardous concentrations of any chemicals.

Field activities will immediately cease if downhole readings exceed 10% LEL. If CGI readings do not subside, the area will be carefully investigated and mapped. Operations may not proceed until readings are below 10% LEL. The area will be immediately evacuated and the situation re-evaluated to determine how to proceed.

If breathing zone concentrations exceed 2 ppm above background or site conditions indicate that additional health and safety precautions are needed, field activities in the area shall stop. Field staff shall notify the Site Supervisor of the situation and he/she shall contact both the Project Manager and the Project Health and Safety Officer. The Project Health and Safety Officer will be responsible for reassessing the hazards and prescribing revised health and safety requirements as necessary, including upgraded PPE requirements, revised work schedules, and revised decontamination procedures. (Typically, PPE will be upgraded to Level C assuming that cartridge respirators are appropriate, otherwise Level B.) See Table 6-1 for specific criteria for each protection level. Work shall not proceed until breathing zone concentrations return to background levels and it is reasonably anticipated that breathing zone samples will stay approximately at background, or the chemical constituent(s) are identified and appropriate PPE is donned.

Field monitoring values will be recorded in a field logbook and copies must be posted for field personnel review.

PIDs, CGIs, and other monitoring equipment shall be calibrated daily or their proper function verified before being used. Throughout the day this equipment shall be periodically checked to ensure that it is working properly. A final calibration shall be conducted at the end of the workday, at which time each instrument will be checked to ensure that it is free from surface contamination. Field staff shall note in their field notebooks that they conducted these calibrations and checks and note whether the equipment functioned properly. Malfunctioning equipment should be brought to the attention of the Site Supervisor or Site Health and Safety Officer, who will arrange to repair and/or replace that equipment as needed.

6.5 Procedures and Equipment for Extreme Hot or Cold Weather Conditions

See CHASP Section 7.5.5.

Severe Weather Conditions

All fieldwork shall immediately cease at the first sign of thunder or lightning. Field personnel shall perform emergency personal and equipment decontamination (see Section 6.6) and seek immediate shelter.

6.6 Personal Decontamination

A CRZ will be established immediate to each sampling/boring site and will include a station for decontaminating equipment and personnel. The CRZ will be covered with sheets of 6-mil polyethylene (typically an area 20 feet x 20 feet is sufficient) with specific stations that will accommodate the removal and disposal of the protective clothing, boot covers, gloves, and respiratory protection, if required.

As a general rule, equipment will be decontaminated using a soap and clean water wash solution. Equipment decontamination will be completed by personnel in Level D PPE. In extreme weather conditions (e.g., lightning) or an emergency requiring immediate evacuation, all contaminated equipment will be wrapped and taped in 6-mil polyethylene sheeting and tagged as "contaminated" for later decontamination.

Personnel working in the CRZ will be in one Level of PPE lower than personnel in the EZ. For example, if personnel in the EZ are in Level B, decontamination workers will be in Level C.

6.6.1 Personal Decontamination Procedures

The decontamination procedures, based on Level D protection, will consist of:

- Brushing heavily soiled boots and rinsing outer gloves and boots with soap and water.

- Removing outer gloves and depositing them in a labeled plastic-lined container.

- Removing outer chemical-protective clothing.

- Washing and rinsing inner gloves.

- Thoroughly washing hard hats and eye protection at the end of each workday with a soap and water solution.

- Discarding disposable gloves and other disposable clothing in resealable bags and placing them in a labeled 55-gallon drum for disposal onsite.

- All field personnel are to be instructed to shower as soon as possible after leaving the site.

Decontamination procedures will be conducted at the lunch break and at the end of each workday. If higher levels of PPE are needed, these procedures will be adjusted and this SSHSP will be amended.

All wastes (soil and water) generated during personal decontamination will be collected in 55-gallon drums, labeled, and staged for final disposal.

6.6.2 Closure of the Personal Decontamination Station

All disposable clothing and plastic sheeting used during site activities will be double-bagged and discarded in a refuse container. Decontamination and rinse solutions will be placed in a 55-gallon drum and labeled for later analysis and disposal. All washtubs, pails, buckets, etc., will be washed, rinsed, and dried at the end of each workday.

6.7 Work Limitations

All site activities will be conducted during daylight only. All personnel scheduled for these activities will have completed initial health and safety training and actual field training as specified in 29 CFR 1910.120(e). All supervisors must complete an additional eight hours of training in site management. All personnel must complete an eight-hour refresher training course annually to continue working onsite.

6.8 Exposure Evaluation

All personnel scheduled for site activities will have had baseline physical examinations which include stressing exams of the neurologic, cardiopulmonary, musculoskeletal and dermatological systems; pulmonary function testing; multichemistry panel; and urinalysis, and have been declared fit for duty. An exposure history form will be completed for each worker participating in site activities. An examination and updated occupational history will be repeated annually and upon termination of employment, as required by 29 CFR 1910.120(f). The content of the annual or termination examination will be the same as the baseline physical. A qualified physician will review the results of the annual examination and exposure data and request further tests or issue medical clearances as appropriate.

After any job-related injury or illness, a medical examination determine fitness for duty or whether any job restrictions are needed. The Site Health and Safety Officer will review the results with the examining physician before releasing the employee for work. A similar examination will be performed if an employee has missed at least three days of work due to a non-job-related injury or illness requiring medical attention. Medical records shall be maintained by the employer or the physician for at least 30 years following the termination of employment.

7.0 MEDICAL MONITORING PROGRAM

See CHASP Section 7.6.

8.0 AUTHORIZED PERSONNEL

Personnel anticipated to be onsite at various times during site activities include:

• Principal-in-Charge	Dr. James Speakman (E/A&H)
• Task Order Manager/Project Manager	Mr. Lawson Anderson (E/A&H)
• Project Health and Safety Officer	Mr. Doug Petty (E/A&H)
• Site Supervisor	Mr. Jim Rathbone (E/A&H)
• Site Health and Safety Officer	Mr. Jim Rathbone (E/A&H)
• Engineer-in-Charge (EIC)	Mr. Mark Taylor (SOUTHDIV)
• NSA Memphis Site Contact	Ms. Tonya Barker

8.1 Responsibilities of Site Supervisor

The Site Supervisor will direct the site operations and, relative to health and safety, is responsible for ensuring that:

- Field staff follow the CHASP, SSHSP, and other safety and health standard operating procedures. Personnel who do not comply are retrained and/or instructed to leave the site and not allowed to return.
- Field staff have current HAZWOPER training.
- Field staff know who the Site Health and Safety Officer is.
- Field staff know the site-specific safety and health concerns.
- The onsite supply of health and safety equipment is adequate.
- Field staff participate in the E/A&H medical surveillance program (or subcontractors, an equivalent program).

- Field staff attend safety and health "kick-off" orientation and other site safety briefings.

The Site Supervisor is also responsible for ensuring that field staff who may be exposed to unique or special hazards have the training or experience necessary to safely conduct their work.

8.2 Responsibilities of Site Health and Safety Officer

The responsibilities of the Site Health and Safety Officer include:

- Providing the Site Supervisor technical input on site health and safety issues.

- Observing field personnel and reporting to the Site Supervisor on the effectiveness of the CHASP and SSHSP and whether field staff are using proper work practices and decontamination procedures.

- Reporting significant safety violations to the Project Manager and/or Project Health and Safety Officer.

- Conducting safety briefings during field activities.

- Ensuring that copies of the CHASP and SSHSP are maintained onsite during all field activities.

- Maintaining a file of HAZWOPER training certificates and appropriate refresher training certificates for onsite personnel.

The Site Health and Safety Officer will have the following qualifications: (1) 40 of hours OSHA training or equivalent experience, (2) 24 hours of supervisory training or equivalent experience, (3) knowledge of the health and safety concerns for the specific tasks being conducted, and (4)

trained to use the air monitoring equipment; able to interpret the data collected with the instruments; familiar with symptoms of chemical exposure, heat stress, and cold exposure; and knows the location and proper use of onsite safety equipment. He will also be familiar with the CHASP and SSHSP.

The position of Site Health and Safety Officer may rotate. Often, particularly on small projects, this function is not a full-time responsibility, rather a member of the field team is selected to serve as the alternate Site Health and Safety Officer. Then when that task is completed and/or field staff change, the alternate Site Health and Safety Officer may change as well. The alternate Health and Safety Officer must meet the criteria for the Site Health and Safety Officer listed above.

The following criteria outline when the Site Health and Safety Officer will be replaced: (1) termination of employment, (2) end of work task, (3) end of shift, (4) sickness, (5) injury, or (6) death. It should be noted that under site work schedules only one shift will be working. As a result, the Site Health and Safety Officer will be responsible for the day shift. If circumstances arise that require work during other periods, an alternate Site Health and Safety Officer will be designated.

8.3 Responsibilities of Onsite Field Staff

The health and safety responsibilities of field staff include:

- Being familiar with and complying with this CHASP and SSHSP.

- Attending site health and safety briefings and being aware of anticipated chemical, physical, and biological hazards and what to do when these hazards are encountered.

- Being properly trained on PPE to be used, safe work practices, decontamination procedures to be followed, and emergency procedures and communications.

- Using required PPE including respiratory protection.

- Having up-to-date HAZWOPER training and providing the Site Supervisor with documentation that training is current.

- Being an up-to-date participant in an acceptable medical surveillance program.

- Being fit-tested and physically capable of using a respirator and being in a position where using a respirator may be a requirement. Should the use of respiratory protection be required, field workers shall not have facial hair which intrudes into the respirator's sealing surface.

- Using the buddy system when wearing respiratory protective equipment. When working in Level C or higher, a third person shall be at the work area. This person shall be suitably equipped to provide logistical and safety support to the entry team.

In addition, field staff should always be alert and use their senses (sight, smell, etc.) to identify and react to potentially hazardous situations. When working in the EZ, visual contact should be maintained between personnel; field personnel should be close enough to assist each other during an emergency. Procedures for leaving a contaminated area must be planned and implemented before going onsite, in accordance with the CHASP and SSHSP.

The number of personnel and the amount of equipment in the contaminated area should be kept to a minimum, consistent with effective site operations. All visitors to the job site must comply

with CHASP and SSHSP procedures. PPE may be modified for visitors depending on the situation. Modifications must be approved by the Project Health and Safety Officer.

9.0 EMERGENCY INFORMATION

All hazardous waste site activities present a risk to onsite personnel. During routine operations risk is minimized by establishing good work practices, staying alert, and using proper PPE. Unpredictable events such as physical injury, chemical exposure, or fire may occur and must be anticipated.

If any situation or unplanned occurrence requires outside or support service, Tonya Barker, NSA Memphis Site Contact, will be informed and the appropriate contact from the following list will be made:

Contact	Agency or Organization	Telephone
Tonya Barker	NSA Memphis	(901) 873-5461/5462
Mark Taylor	SOUTHDIV EIC	(803) 743-0573
Law Enforcement	NSA Memphis Base Security	9-911
Fire Department	NSA Memphis	9-911
Ambulance Service	Naval Hospital, Millington Navy Road	(901) 873-5801/5802 or 9-911
Hospital	Methodist North Hospital 3960 Covington Pike	(901) 372-5211 or 9-911
Southern Poison Control Center	—	(901) 528-6048
Lawson Anderson	EnSafe/Allen & Hoshall	(901) 372-7962
Doug Petty	EnSafe/Allen & Hoshall	(901) 372-7962 (901) 362-0252

Mark Taylor, SOUTHDIV EIC, will be contacted after appropriate emergency measures have been initiated onsite.

9.1 Site Resources

Cellular telephones or the telephone at the nearby Aircraft Fire Fighting Training Facility trailer are available for emergency use and communication/coordination with NSA Memphis. First-aid and eye wash equipment will be available at the work area.

9.2 Emergency Procedures

Conditions that may constitute an emergency include any member of the field crew being involved in an accident or experiencing any adverse effects or symptoms of exposure while onsite, or if a condition is identified that suggests the existence of a situation more hazardous than anticipated.

The following emergency procedures should be followed:

- Site work area entrance and exit routes will be planned and emergency escape routes delineated by the Site Health and Safety Officer. Copies of emergency contacts and routes will be posted onsite.

- If any member of the field team experiences any effects or symptoms of exposure while on the scene, the entire field crew will immediately stop work and act according to the instructions of the Site Health and Safety Officer.

- For applicable site activities, wind indicators visible to all onsite personnel will be provided by the Site Health and Safety Officer to indicate possible routes for upwind escape.

- The discovery of any conditions that would suggest the situation is more hazardous than anticipated will result in the suspension of work until the Site Health and Safety Officer has evaluated the situation and provided the appropriate instructions to the field team.

- If an accident occurs, the Field Project Manager is to complete an Accident Report Form (see Attachment B) for submittal to the managing principal-in-charge of the project.

- If a member of the field crew suffers a personal injury, the Site Health and Safety Officer will call **(901) 372-5211 or 9-911** (serious injury) to alert appropriate emergency response agencies or administer onsite first aid (minor injury) as the situation dictates. An Accident Report Form will be completed for any such incident.

- If a member of the field crew suffers chemical exposure, the affected areas should be flushed immediately with copious amounts of clean water, and if the situation dictates, the Site Health and Safety Officer should alert appropriate emergency response agencies, or personally ensure that the exposed individual is transported to the nearest medical treatment facility for prompt treatment. (See Attachment C for directions.) An Accident Report Form will be completed for any such incident.

Additional information on appropriate chemical exposure treatment methods will be provided through MSDSs in Attachment A.

10.0 FORMS

The following forms will be used to implement this SSHSP:

- Plan Feedback Form
- Exposure History Form
- Accident Report Form

The Plan Acceptance Form will be filled out by all employees working onsite before site activities begin. The Plan Feedback Form will be filled out by the Site Health and Safety Officer and any other onsite employee who wishes to fill one out. The Exposure History Form will be completed by both the Field Project Manager and the individual(s) for whom the form is intended. Examples of each form are provided in Attachment B of this plan.

All completed forms must be returned to the Task Order Manager at EnSafe/Allen & Hoshall, Memphis, Tennessee.

ATTACHMENT A

MATERIAL SAFETY DATA SHEETS

CHEMTOX DATA

---------- IDENTIFIERS ----------

CHEMTOX RECORD 398 LAST UPDATE OF THIS RECORD: 11/24/95

NAME:	TOLUENE		
SYNONYMS:	TOLUOL; PHENYL METHANE; METHYL BENZENE; BENZENE, METHYL-		
CAS:	108-88-3	RTECS:	XS5250000
FORMULA:	C7H8	MOL WT:	92
WLN:	1R		
CHEMICAL CLASS:	Aromatic hydrocarbon		

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION: colorless watery liquid with a sweet, pungent, benzene-like odor

BOILING POINT:	383.6 K	110.4 C	230.8 F
MELTING POINT:	178.00 K	-95.2 C	-139.3 F
FLASH POINT:	277.6 K	4.45 C	40 F
AUTO IGNITION:	809 K	535.8 C	996.6 F
CRITICAL TEMP:	591.8 K	318.65 C	605.57 F
CRITICAL PRESS:	4.108 kN/M2	40.5 atm	595 psia
HEAT OF VAP:	155 Btu/lb	86.08 cal/g	3.601x E5 J/kg
HEAT OF COMB:	-17430 Btu/lb	-9690 cal/g	-405x E5 J/kg

VAPOR PRESSURE:	21 mm @ 20 C
UEL:	7.1 %
LEL:	1.3 %
IONIZATION POTENTIAL (eV):	8.82
VAPOR DENSITY:	3.14 (air=1)
EVAPORATION RATE:	2.00(n-BUTYL ACETATE=1)
SPECIFIC GRAVITY:	0.867 @ 20 C
DENSITY:	0.867
WATER SOLUBILITY:	0.05%
INCOMPATIBILITIES:	strong ox
REACTIVITY WITH WATER:	No data on water reactivity
REACTIVITY WITH COMMON MATERIALS:	No data
STABILITY DURING TRANSPORT:	No Data
NEUTRALIZING AGENTS:	No data
POLYMERIZATION POSSIBILITIES:	No data
TOXIC FIRE GASES:	None reported other than possible unburned vapors
ODOR DETECTED AT (ppm):	40 PPM
ODOR DESCRIPTION:	STRONG, PLEASANT Source:NYDH
100 % ODOR DETECTION:	No data

---------- REGULATIONS ----------

DOT hazard class: 3 FLAMMABLE LIQUID
DOT guide: 27
Identification number: UN1294
DOT shipping name: Toluene
Packing group: II
Label(s) required: FLAMMABLE LIQUID
Special provisions: T1
Packaging exceptions: 173.150
Non bulk packaging: 173.202
Bulk packaging: 173.242
Quantity limitations-
Passenger air/rail: 5 L
Cargo aircraft only: 60 L
Vessel stowage: B
Other stowage provisions:

STCC NUMBER: 4909305

CLEAN WATER ACT Sect.307:Yes
CLEAN WATER ACT Sect.311:Yes
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 1 mg/L (07/30/92)
Maximum Contaminant Level Goals (MCLG): 1 mg/L (07/30/92)
CLEAN AIR ACT: CAA '90 Listed
EPA WASTE NUMBER: U220,D001
CERCLA REF: Not listed
RQ DESIGNATION: C 1000 pounds (454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Acute toxicity: Irritant
Acute toxicity: adverse effect to target organs.
Chronic toxicity: adverse effect to target organ after long period of exposure.
Chronic toxicity: mutagen.
Chronic toxicity: reproductive toxin.

Fire hazard: flammable.
Chronic toxicity: carcinogen
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 1.0 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: Flammable liquid - Mailable as ORM-D
Mailability: Domestic surface mail only
Max per parcel: 1 QT METAL; 1 PT OTHER

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.

REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON ----------

ACGIH TLV list "Threshold Limit Values for 1992-1993"
ATSDR Toxicology Profile available (NTIS** PB/90/198904/AS)
California Assembly Bill 1803 Well Monitoring Chemicals.
California Assembly Bill 2588 Air Toxics "Hot Spots" Chemicals.
California Department of Health Services Drinking Water Action List.
California Proposition 65 Developmental Toxin List
Canadian Domestic Substances List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
Clean Air Act Section 111 List.
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 307 Priority Pollutants
Clean Water Act Section 311 Hazardous Chemicals List.
DOT Hazardous Materials Table. 49 CFR 172.101
EPA Carcinogen Assessment Group List
EPA List of VOC chemicals from 40 CFR 60.489
EPA TSCA 8(a) Preliminary Assessment Information Rule - effective 11/19/82
EPA TSCA 8(d) Health and Safety Data Rule - effective date 10/04/82
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
Massachusetts Substance List.
New Jersey Right To Know Substance List. (December 1987)
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
OSHA Process Safety Rule chemical with a TQ. Effective May 26, 1992
Pennsylvania Hazardous Substance List
RCRA Hazardous Constituents for Ground Water Monitoring. Ap'dx IX to 40 CFR 264
RCRA Hazardous Waste
SARA Section 110 Priority List of CERCLA Hazardous Substances
SARA Section 313 Toxic Chemicals List
Superfund/CERCLA RQ list. Table 302.4 in 54 FR 50968 (December 11, 1989)
TOLUENE [108-88-3]
Washington State Discarded Chemical Products List, November 17, 1989
Wisconsin Air Toxics Control Regulation NR-445 (December 1988)

---------- TOXICITY DATA ----------

SHORT TERM TOXICITY: INHALATION: 100 ppm exposure can cause dizziness, drowsiness and hallucinations. 100-200 ppm can cause depression. 200-500 ppm can cause headaches, nausea, loss of appetite, loss of energy, loss of coordination and coma. in addition to the above, death has resulted from exposure to 10,000 ppm for an unknown time. SKIN: can cause dryness and irritation.

absorption may cause or increase the severity of symptoms listed above. Eyes: can cause irritation at 300 ppm. INGESTION: can cause a burning sensation in the mouth and stomach, upper abdominal pain, cough, hoarseness, headache, nausea, loss of appetite, loss of energy, loss of coordination and coma.(NYDH)

LONG TERM TOXICITY: levels below 200 ppm may produce headache, tiredness and nausea. from 200 to 750 ppm symptoms may include insomnia, irritability, dizziness, some loss of memory, loss of appetite, a feeling of drunkeness and disturbed menstruation. levels up to 1,500 ppm may cause heart palpitations and loss of coordination. blood effects and anemia have been reported but are probably due to contamination by benzene. most of these effects area believed to go away when exposure stops.(NYDH)

TARGET ORGANS: CNS, liver, kidneys, skin, eyes, resp sys

SYMPTOMS: Vapors irritate eyes and upper respiratory tract; cause dizziness, headache, anesthesia, respiratory arrest. Liquid irritates eyes and causes drying of skin. If aspirated, causes coughing, gagging, distress, and rapidly developing pulmonary edema. If ingested causes vomiting, griping, diarrhea, depressed respiration. Source: CHRIS

CONC IDLH: 500ppm

NIOSH REL: 100 ppm Time weighted averages for 8-hour exposure
375 mg/M3 Time weighted averages for 8-hour exposure
200 ppm Ceiling exposures which shall at no time be exceeded(10-MIN) 750 mg/M3 Ceiling exposures which shall at no time be exceeded(10-MIN)

ACGIH TLV: TLV = 50ppm(188 mg/M3) Skin
ACGIH STEL: Not listed

OSHA PEL: Transitional Limits:
PEL = 200 PPM; CEILING = 300 PPM; MAXIMUM PEAK ABOVE CEILING
Final Rule Limits:
TWA = 100 ppm (375 mg/M3)
STEL = 150 ppm(560 mg/M3)

MAK INFORMATION: 50 ppm
190 mG/M3
Substance with systemic effects, onset of effect less than or equal to 2 hrs: Peak = 5xMAK for 30 minutes, 2 times per shift of 8 hours.
There is no reason to fear a risk of damage to the developing embryo or fetus when MAK values are adhered

to.

CARCINOGEN?: N STATUS: See below

CARCINOGEN LISTS:

IARC: Not classified as to human carcinogenicity or probably not carcinogenic to humans.
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)

* orl-hmn LDLo:50 mg/kg YAKUD5 22,883,80

ihl-hmn TCLo:200 ppm JAMAAP 123,1106,43
BRAIN AND COVERINGS
Recordings from specific areas of CNS
BEHAVIORAL
Antipsychotic
BLOOD
Changes in bone marrow not included above

LD50 value: orl-rat LD50:636 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:636 mg/kg
ihl-rat LC50:>26700 ppm/1H
ipr-rat LD50:1332 mg/kg
ivn-rat LD50:1960 mg/kg
unr-rat LD50:6900 mg/kg
ihl-mus LC50:400 ppm/24H
ipr-mus LD50:59 mg/kg
scu-mus LD50:2250 mg/kg
unr-mus LD50:2 gm/kg
ihl-rbt LCLo:55000 ppm/40M
skn-rbt LD50:12124 mg/kg
ivn-rbt LDLo:130 mg/kg
ihl-gpg LCLo:1600 ppm
ipr-gpg LD50:500 mg/kg
scu-frg LDLo:920 mg/kg
ipr-mam LDLo:1750 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)

ihl-rat TCLo:1500 mg/m3/24H (1-8D preg) TXCYAC 11,55,78
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:1000 mg/m3/24H (7-14D preg) FMORAO 28,286,80
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:800 mg/m3/6H (14-20D preg) BJMRDK 23,533,90
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
EFFECTS ON NEWBORN
Behavioral

orl-mus TDLo:9 gm/kg (6-15D preg) TJADAB 19,41A,79
EFFECTS ON EMBRYO OR FETUS
Fetal death

orl-mus TDLo:15 gm/kg (6-15D preg) TJADAB 19,41A,79
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

orl-mus TDLo:30 gm/kg (6-15D preg) TJADAB 19,41A,79
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Craniofacial(including nose and tongue)

ihl-mus TCLo:500 mg/m3/24H (6-13D preg) TXCYAC 11,55,78
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-mus TCLo:1000 ppm/6H (2-17D preg) TJEMDR 7,265,82
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-mus TCLo:400 ppm/7H (7-16D preg) FAATDF 6,145,86
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system
EFFECTS ON NEWBORN

ihl-mus TCLo:200 ppm/7H (7-16D preg) FAATDF 6,145,86
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Urogenital system

ihl-rbt TCLo:1 gm/m3/24H (7-20D preg) ATSUDG 8,425,85
EFFECTS ON FERTILITY
Abortion

ihl-rbt TDLo:100 ppm/6H (6-18D preg) ARTODN 66,373,92

SPECIFIC DEVELOPMENTAL ABNORMALITIES
Cardiovascular(circulatory)system

California Prop 65: Developmental toxin (01/01/91)
Acceptable intake level-inhalation 13000. ugD (01/01/94)
Acceptable intake level-oral intake 7000. ugD (01/01/94)

---------- EPA's IRIS DATA SUMMARY ----------

Toluene; CASRN 108-88-3 (04/01/92)

_II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Toluene
CASRN -- 108-88-3
Last Revised -- 08/01/90

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quantitative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

__II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

___II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- D; not classified

Basis -- No human data and inadequate animal data. Toluene did not produce positive results in the majority of genotoxic assays.

___II.A.2. HUMAN CARCINOGENICITY DATA

None.

___II.A.3. ANIMAL CARCINOGENICITY DATA

A chronic (106-week) bioassay of toluene in F344 rats of both sexes reported no carcinogenic responses (CIIT, 1980). A total of 960 rats were exposed by inhalation for 6 hours/day, 5 days/week to toluene at 0, 30, 100, or 300 ppm. Groups of 20/sex/dose were sacrificed at 18 months. Gross and microscopic examination of tissues and organs identified no increase in neoplastic tissue or tumor masses among treated rats when compared with controls. The study is considered inadequate because the highest dose administered was well below the MTD for toluene and because of the high incidence of lesions and pathological changes in the control animals.

Several studies have examined the carcinogenicity of toluene following repeated dermal applications. Toluene (dose not reported) applied to shaved interscapular skin of 54 male mice (strains A/He, C3HeB, SWR) throughout their lifetime (3 times weekly) produced no carcinogenic response (Poel, 1963). One drop of toluene (about 6 mL) applied to the dorsal skin of 20 random-bred albino mice twice weekly for 50 weeks caused no skin papillomas or carcinomas after a 1-year latency period was allowed (Coombs et al., 1973). No increase in the incidence of skin or systemic tumors was demonstrated in male or female mice of three strains (CF, C3H, or CBaH) when toluene was applied to the back of 25 mice of each sex of each strain at 0.05-0.1 mL/mouse, twice weekly for 56 weeks (Doak et al., 1976). One skin papilloma and a single skin carcinoma were reported among a group of 30 mice treated dermally with one drop of 0.2% (w/v) solution toluene twice weekly, administered from droppers delivering 16-20 uL per drop for 72 weeks (Lijinsky and Garcia, 1972). It is not reported whether evaporation of toluene from the skin was prevented during these studies.

___II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

Toluene was found to be nonmutagenic in reverse mutation assays with S. typhimurium (Mortelmans and Riccio, 1980; Nestmann et al., 1980; Bos et al., 1981; Litton Bionetics, Inc., 1981; Snow et al., 1981) and E. coli (Mortelmans and Riccio, 1980), with and without metabolic activation. Toluene did not induce mitotic gene conversion (Litton Bionetics, Inc., 1981; Mortelmans and Riccio, 1980) or mitotic crossing over (Mortelmans and Riccio, 1980) in S. cerevisiae. Although Litton Bionetics, Inc. (1981) reported that toluene did not cause increased chromosomal aberrations in bone marrow cells, several Russian studies (Dobrokhotov, 1972; Lyapkalo, 1973) report toluene as effective in causing chromosal damage in bone marrow cells of rats. There was no evidence of chromosomal aberrations in blood lymphocytes of workers exposed to toluene only (Maki-Paakkanen et al., 1980; Forni et al., 1971), although a slight increase was noted in workers exposed to toluene and benzene (Forni et al., 1971; Funes-Craviota et al., 1977). This finding is supported by studies of cultured human lymphocytes exposed to toluene in vitro; no elevation of chromosomal aberrations or sister chromatid exchanges was observed (Gerner-Smidt and Friedrich, 1978).

__II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

Not available.

__II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

Not available.

__II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

___II.D.1. EPA DOCUMENTATION

U.S. EPA. 1987. Drinking Water Criteria Document for Toluene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Drinking Water, Washington, DC. ECAO-CIN-408.

___II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The values in the 1987 Drinking Water Criteria Document for Toluene have received peer and administrative review.

Agency Work Group Review: 09/15/87

Verification Date: 09/15/87

___II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

Dharm V. Singh / ORD -- (202)260-5958 / FTS 260-5958

Robert E. McGaughy / ORD -- (202)260-5898 / FTS 260-5898

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly when skin becomes wet.

** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammability

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
NIOSH (TOLUENE)
1000 ppm: Any chemical cartridge respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any supplied-air respirator. * Substance reported to cause eye irritation or damage may require eye protection. / Any powered air-purifying respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus. * Substance reported to cause eye irritation or damage may require eye protection.
2000 ppm: Any supplied-air respirator operated in a continuous flow mode. * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus with a full facepiece. / Any supplied-air respirator with a full facepiece. / Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister.
EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.: Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID SOURCE: NIOSH
EYE: irr immed
SKIN: soap wash promptly
INHALATION: art resp
INGESTION: no vomit

FIRST AID SOURCE: CHRIS Manual 1991
INHALATION: remove to fresh air, give artificial respiration and oxygen

if needed; call a doctor.
INGESTION: do NOT induce vomiting; call a doctor.
EYES: flush with water for at least 15 min.
SKIN: wipe off, wash with soap and water.

FIRST AID SOURCE: DOT Emergency Response Guide 1990.
Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

---------- INITIAL INCIDENT RESPONSE ----------

FIRE EXTINGUISHMENT: Carbon dioxide or dry chemical for small fires, ordinary foam for large fires. Note: Water may be ineffective CHRIS91

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: Toluene
DOT ID NUMBER: UN1294

ERG93 GUIDE 27

POTENTIAL HAZARDS

*FIRE OR EXPLOSION
Flammable/combustible material; may be ignited by heat, sparks or flames.
Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.
Vapor explosion hazard indoors, outdoors or in sewers.
Runoff to sewer may create fire or explosion hazard.
Material may be transported hot.
*HEALTH HAZARDS
May be poisonous if inhaled or absorbed through skin.
Vapors may cause dizziness or suffocation.
Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind; keep out of low areas. Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection. *Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC AT 1-800-424-9300. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until

well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

*SPILL OR LEAK

Shut off ignition sources; no flares, smoking or flames in hazard area. Stop leak if you can do it without risk. Water spray may reduce vapor; but it may not prevent ignition in closed spaces.

Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.

Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

CHEMTOX DATA

---------- IDENTIFIERS ----------

CHEMTOX RECORD 247 LAST UPDATE OF THIS RECORD: 11/24/95

NAME:	LEAD
SYNONYMS:	C.I. PIGMENT METAL 4; C.I. 77575; KS-4; LEAD FLAKE; LEAD S2; OLOW (Polish); SI; SO
CAS:	7439-92-1 RTECS: OF7525000
FORMULA:	Pb MOL WT: 207.19
WLN:	PB
CHEMICAL CLASS:	Metal

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION:	bluish-grey, soft metal; heavy ductile, soft, gray solid
BOILING POINT:	2013 K 1739.8 C 3163.7 F
MELTING POINT:	600.6 K 327.4 C 621.4 F
FLASH POINT:	Not available
AUTO IGNITION:	Not available
VAPOR PRESSURE:	1mm @ 973 C
UEL:	~
LEL:	~
VAPOR DENSITY:	No data
SPECIFIC GRAVITY:	11.34
DENSITY:	11.34 g/mL @ 20 C
WATER SOLUBILITY:	INSOLUBLE; DISSOLVES SLOWLY IN WATER CONTAINING A WEAK ACID
INCOMPATIBILITIES:	strong ox, hydrogen peroxide, active metals, sodium, potassium, chlorine trifluoride, hydrogen peroxide, zirconium, disdium acetylide, oxidants, acids
REACTIVITY WITH WATER:	No data on water reactivity
REACTIVITY WITH COMMON MATERIALS:	RELATIVELY IMPENETRABLE TO RADIATION
STABILITY DURING TRANSPORT:	No Data
NEUTRALIZING AGENTS:	No data
POLYMERIZATION POSSIBILITIES:	No data
TOXIC FIRE GASES:	WHEN HEATED EMITS HIGHLY TOXIC FUMES; CAN REACT VIGOROUSLY WITH OXIDIZING MATERIALS
ODOR DETECTED AT (ppm):	Unknown
ODOR DESCRIPTION:	No data
100 % ODOR DETECTION:	No data

---------- REGULATIONS ----------

National Primary Ambient Air Quality Standards
1.5 ug/M3 maximum arithmetic mean averaged over a calendar year
National Secondary Ambient Air Quality Standards
same as primary standard

DOT hazard class:	6.1 POISON
DOT guide:	53
Identification number:	UN2291
DOT shipping name:	LEAD COMPOUNDS, SOLUBLE, N.O.S.
Packing group:	III
Label(s) required:	KEEP AWAY FROM FOOD
Special provisions:	
Packaging exceptions:	173.153
Non bulk packaging:	173.213
Bulk packaging:	173.240
Quantity limitations-	
Passenger air/rail:	100 KG
Cargo aircraft only:	200 KG
Vessel stowage:	A
Other stowage provisions:	

STCC NUMBER: Not listed

CLEAN WATER ACT Sect.307:Yes
CLEAN WATER ACT Sect.311:No
National Primary Drinking Water Regulations
  Maximum Contaminant Levels (MCL): Treatment technique (12/07/92)
  Maximum Contaminant Level Goals (MCLG): 0 mg/L (12/07/92)
CLEAN AIR ACT: CAA '90 Listed and CAA '77 Sect 109
EPA WASTE NUMBER: D008
CERCLA REF: Y
RQ DESIGNATION: A 10 pounds (4.54 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Chronic toxicity: carcinogen
Chronic toxicity: adverse effect to target organ after long period of exposure.
Chronic toxicity: mutagen.
Chronic toxicity: reproductive toxin.

LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 0.1 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: ORM-B
Mailability: Domestic service and air transportation; shipper's declaration
Max per parcel: 25 LBS; 5 LBS

---------- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON ----------

ACGIH TLV list "Threshold Limit Values for 1992-1993"
California Assembly Bill 2588 Air Toxics "Hot Spots" Chemicals.
California Assembly Bill 1807 Toxic Air Contaminants.
California Proposition 65 Developmental Toxin List
California Proposition 65 Female Reproductive Toxin List
California Proposition 65 Male Reproductive Toxin List
Canadian Domestic Substances List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
Clean Air Act Section 109 National Ambient Air Quality Standards List
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 307 Priority Pollutants
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
LEAD [7439-92-1]
Massachusetts Substance List.
New Jersey DEQ100 list for release reporting.
New Jersey Right To Know Substance List. (December 1987)
New Jersey Right to Know Substance List. Listed as a teratogen.
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
OSHA Specifically regulated substance. See 29 CFR 1910.1025
Pennsylvania Hazardous Substance List
RCRA Hazardous Waste
RCRA Toxicity Characteristics (TC) list dated March 29, 1990
SARA Section 313 Toxic Chemicals List

---------- TOXICITY DATA ----------

SHORT TERM TOXICITY: LASSITUDE, INSOMNIA, PALLOR, EYE GROUNDS,
ANOREXIA, LOW-WEIGHT, MALNUTRITION,
CONSTIPATION, ABDOMINAL PAIN, COLIC;
HYPOTENSE, ANEMIA; GINGIVAL LEAD LINE;
TREMBLING PARALYSIS WRIST. ** Source: 2

LONG TERM TOXICITY: unknown

TARGET ORGANS: gi,CNS,kidneys,blood,gingival tissue,eyes

SYMPTOMS: INHALATION, INGESTION, CONTACT:
ENCEPHALOPATHY; KIDNEY DISEASE; IRRIT EYES;
HYPOTENSION, WEAKNESS, FACIAL PALLOR,
LASSITUDE, INSOMNIA, PAL, EYE GROUNDS,
ANOREXIA, WEIGHT LOSS, MALNUTRITION,
CONSTIPATION, ABDOM PAIN, COLIC; HYPOTENSION,
ANEMIA, GINGIVAL LEAD LINE; TREMORS,
PARALYSIS WRIST, ANKLES. METALLIC TASTE,
INCREASED SALIVATION, PYORRHEA (FLOW OF
MUCOUS). NEUROMUSCULAR: NUMBNESS AND TINGLING

OF EXTREMITIES WITH SENSORY DISTRUBANCE, EXTENSOR WEAKNESS OF WRISTS AND ANKLES, LOSS OF MUSCLE TONE, TREMOR INCREASED DEEP-TENDON REFLEXES, MUSCULAR CRAMPS AND ACHING, MUSCULAR ATROPHY. CNS: VISUAL DISTURBANCES, HEADACHE, NERVOUSNESS OF DEPRESSION, INSOMNIA, MENTAL CONFUSION, DELIRIUM. Source: NIOSHP, THIC

CONC IDLH: 100mg/m3(ASPb)

NIOSH REL: <0.1 mg/M3 Air level to be maintained so that worker blood level remains <0.06 mg/100 g of whole blood

ACGIH TLV: TLV = 0.15mg/M3 as LEAD
ACGIH STEL: Not listed

OSHA PEL: Final Rule Limits:
TWA = See 29 CFR 1910.1025 and 1926.62
50 ug/M3

MAK INFORMATION: 0.1 calculated as total dust mG/M3
Substance with systemic effects, onset of effect over 2 hours: Peak = 10xMAK for 30 minutes, once per shift of 8 hours.
Risk of damage to the developing embryo or fetus must be considered probable. Damage cannot be excluded even when the MAK values are adhered to.

CARCINOGEN?: Y STATUS: See below

CARCINOGEN LISTS:

IARC: Carcinogen defined by IARC to be possibly carcinogenic to humans, but having (usually) no human evidence.
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Animal carcinogen. The chemical is carcinogenic in experimental animals at a relatively high dose, by routes or administration, at sites, or histological types, or by mechanisms that are not considered relevant to worker exposure.
OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)
orl-wmn TDLo:450 mg/kg/6Y JAMAAP 237,2627,77
PERIPHERAL NERVE AND SENSATION

Flaccid paralysis without anesthesia
BEHAVIORAL
Hallucinations, distorted perceptions
BEHAVIORAL
Muscle weakness

LD50 value: No LD50 in RTECS 1992

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

ipr-rat LDLo:1 gm/kg
orl-pgn LDLo:160 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)
orl-rat TDLo:790 mg/kg (multigenerations) AEHLAU 23,102,71
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
EFFECTS ON EMBRYO OR FETUS
Fetal death

orl-rat TDLo:1140 mg/kg (14D pre-21D post) PHMCAA 20,201,78
EFFECTS ON NEWBORN
Behavioral

orl-rat TDLo:520 mg/kg (7-22D preg/10D post) FEPRA7 37,394,78
EFFECTS ON NEWBORN

orl-rat TDLo:1100 mg/kg (1-22D preg) FEPRA7 37,895,78
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Blood and lymphatic systems(including spleen and marrow)
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)

ihl-rat TCLo:10 mg/m3/24H (1-21D preg) ZHPMAT 165,294,77
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Blood and lymphatic systems(including spleen and marrow)

ihl-rat TCLo:3 mg/m3/24H (1-21D preg) ZHPMAT 165,294,77

EFFECTS ON NEWBORN

orl-mus TDLo:1120 mg/kg (multigenerations) AEHLAU 23,102,71
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
EFFECTS ON EMBRYO OR FETUS
Fetal death

orl-mus TDLo:6300 mg/kg (1-21D preg) EXPEAM 31,1312,75
EFFECTS ON FERTILITY
Female fertility index
EFFECTS ON FERTILITY
Pre-implantation mortility

orl-mus TDLo:300 mg/kg (1-2D preg) TXCYAC 6,129,76
EFFECTS ON FERTILITY
Other measures of fertility

orl-mus TDLo:4800 mg/kg (1-16D preg) BECTA6 18,271,77
EFFECTS ON EMBRYO OR FETUS
Cytological changes(including somatic cell genetic material)

orl-dom TDLo:662 mg/kg (1-21W preg) TXAPA9 25,466,73
EFFECTS ON NEWBORN
Behavioral

California Prop 65: Developmental toxin (02/27/87)
Female reproductive toxin (02/27/87)
Male reproductive toxin (02/27/87)
Acceptable intake level-inhalation .5 ugD (01/01/94)
Carcinogen (10/01/92)

---------- EPA's IRIS DATA SUMMARY ----------

Lead and compounds (inorganic); CASRN 7439-92-1 (04/01/92)

_II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Lead and compounds (inorganic)
CASRN -- 7439-92-1
Last Revised -- 05/01/91

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quantitative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L

drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

__II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

___II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- B2; probable human carcinogen

Basis -- Sufficient animal evidence. Ten rat bioassays and one mouse assay have shown statistically significant increases in renal tumors with dietary and subcutaneous exposure to several soluble lead salts. Animal assays provide reproducible results in several laboratories, in multiple rat strains with some evidence of multiple tumor sites. Short term studies show that lead affects gene expression. Human evidence is inadequate.

___II.A.2. HUMAN CARCINOGENICITY DATA

Inadequate. There are four epidemiologic studies of occupational cohorts exposed to lead and lead compounds. Two studies (Dingwall-Fordyce and Lane, 1963; Nelson et al., 1982) did not find any association between exposure and cancer mortality. Selevan et al. (1985), in their retrospective cohort mortality study of primary lead smelter workers, found a slight decrease in the total cancer mortality (SMR=95). Apparent excesses were observed for respiratory cancer (SMR=111, obs=41, $p>0.05$) and kidney cancer (SMR=204, obs=6, $p>0.05$). Cooper and Gaffey (1975) and Cooper (1985 update) performed a cohort mortality study of battery plant workers and lead smelter workers. They found statistically significant excesses for total cancer mortality (SMR=113, obs=344), stomach cancer (SMR=168, obs=34), and lung cancer (SMR=124, obs=109) in the battery plant workers. Although similar excesses were observed in the smelter workers, they were not statistically significant. Cooper and Gaffey (1975) felt it was possible that individual subjects were monitored primarily on the basis of obvious signs of lead exposure, while others who showed no symptoms of lead poisoning were not monitored.

All of the available studies lacked quantitative exposure information, as well as information on the possible contribution from smoking. All studies also included exposures to other metals such as arsenic, cadmium, and zinc for which no adjustment was done. The cancer excesses observed in the lung and stomach were relatively small (<200). There was no consistency of site among the various studies, and no study showed any dose-response relationship. Thus, the available human evidence is considered to be inadequate to refute or demonstrate any potential carcinogenicity for humans from lead exposure.

___II.A.3. ANIMAL CARCINOGENICITY DATA

Sufficient. The carcinogenic potential of lead salts (primarily phosphates and acetates) administered via the oral route or by injection has been demonstrated in rats and mice by more than 10 investigators. The most characteristic cancer response is bilateral renal carcinoma. Rats given lead acetate or subacetate orally have developed gliomas, and lead subacetate also produced lung adenomas in mice after i.p. adminstration. Most of these investigations found a carcinogenic response only at the highest dose. The lead compounds tested in animals are almost all soluble salts. Metallic lead, lead oxide and lead tetralkyls have not been tested adequately. Studies of inhalation exposure have not been located in the literature.

Azar et al. (1973) administerd 10, 50, 100, and 500 ppm lead as lead acetate in dietary concentrations to 50 rats/sex/group for 2 years. Control rats (100/sex) received the basal laboratory diet. In a second 2-year feeding study, 20 rats/group were given diets containing 0, 1000, and 2000 ppm lead as lead acetate. No renal tumors were reported in the control groups or in treated animals of either sex receiving 10 to 100 ppm. Male rats fed 500, 1000, and 2000 ppm lead acetate had an increased renal tumor incidence of 5/50, 10/20, and 16/20, while 7/20 females in the 2000-ppm group developed renal tumors.

The Azar et al. (1973) study is limited by the lack of experimental detail. The possibility of environmental contamination from lead in the air or drinking water was not mentioned. The strains of rats used were not specified in the study, but the Health Effects Assessment for Lead (U.S. EPA, 1984) indicates the rats were Wistar strain. The weight gain at 1000 and 2000 ppm was reported to be depressed, but details were not given.

Kasprzak et al. (1985), in investigating the interaction of dietary calcium on lead carcinogenicity, fed 1% lead subacetate (8500 ppm Pb) to male Sprague-Dawley rats in the diet for 79 weeks. Of the rats surviving (29/30) in this treatment group beyond 58 weeks, 44.8% had renal tumors. Four rats had adenocarcinomas; the remainaing nine had adenomas. Bilateral tumors were noted. No renal tumors were noted among the controls.

As part of a study to determine interactions between sodium nitrite, ethyl urea and lead, male Sprague-Dawley rats were given lead acetate in their drinking water for 76 weeks (Koller et al., 1986). The concentration of lead was 2600 ppm. No kidney tumors were detected among the 10 control rats. Thirteen of 16 (81%) lead-treated rats had renal tubular carcinoma; three tumors were detected at 72 weeks and the remainder detected at the termination of the study.

Van Esch and Kroes (1969) fed basic lead acetate at 0, 0.1%, and 1.0% in the diet to 25 Swiss mice/sex/group for 2 years. No renal tumors developed in the control group, but 6/25 male mice of 0.1% basic lead acetate group had renal tumors (adenomas and carcinomas combined). In the 1.0% group, one female had a renal tumor. The authors thought that the low incidence in the 1.0% group was due to early mortality.

Hamsters given lead subacetate at 0.5% and 1% in the diet had no significant renal tumor response (Van Esch and Kroes, 1969).

___II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

Lead acetate induces cell transformation in Syrian hamster embryo cells (DiPaolo et al., 1978) and also enhances the incidence of simian adenovirus induction. Lead oxide showed similar enhanced adenovirus induction (Casto et al., 1979).

Under certain conditions lead compounds are capable of inducing chromosomal aberrations in vivo and in tissue cultures. Grandjean et al. (1983) showed a relationship between SCE and lead exposure in exposed workers. Lead has been shown, in a number of DNA structure and function assays, to affect the molecular processes associated with the regulation of gene expression (U.S. EPA, 1986).

__II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

Not available.

Quantifying lead's cancer risk involves many uncertainties, some of which may be unique to lead. Age, health, nutritional state, body burden, and exposure duration influence the absorption, release, and excretion of lead. In addition, current knowledge of lead pharmacokinetics indicates that an estimate derived by standard procedures would not truly describe the potential risk. Thus, the Carcinogen Assessment Group recommends that a numerical estimate not be used.

__II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

Not available.

__II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

___II.D.1. EPA DOCUMENTATION

U.S. EPA. 1984. Health Effects Assessment for Lead. Prepared by the Office

of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH, for the Office of Emergency and Remedial Response, Washington, DC. EPA/540/1-86/055. NTIS PB85-163996/AS.

U.S. EPA. 1986. Air Quality Criteria Document for Lead. Volumes III, IV. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Research Triangle Park, NC, for the Office of Air Quality Planning and Standards. EPA-600/8-83/028dF.

U.S. EPA. 1987. Preliminary review of the carcinogenic potential of lead associated with oral exposure. Prepared by the Office of Health and Environmental Assessment, Carcinogenic Assessment Group, Washington DC, for the Office of Drinking Water, Office of Solid Waste and the Office of Emergency and Remedial Response (Superfund). OHEA-C-267. Internal Review Draft.

___II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The review of the carcinogenic potential of lead associated with oral exposure has received Agency review.

The 1986 Air Quality Criteria Document for Lead has received Agency and External Review.

Agency Work Group Review: 05/04/88

Verification Date: 05/04/88

___II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

William Pepelko / ORD -- (202)260-5898 / FTS 260-5898

James Cogliano / ORD -- (202)260-9243 / FTS 260-9243

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
At the end of each work shift.

** REMOVE CLOTHING:
Promptly remove non-impervious clothing that becomes contaminated.

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
OSHA (LEAD)
Not in excess of 0.5 mg/M3: Half-mask, air-purifying respirator equipped with high efficiency filters.
Not in excess of 2.5 mg/M3: Full facepiece air-purifying respirator equipped with high-efficiency filters.
Not in excess of 50 mg/M3: (1) Any powered, air-purifying respirator with high efficiency filters; or (2) Half-mask supplied-air respirator operated in positive-pressure mode.
Not in excess of 100 mg/M3: Supplied air respirator with full facepiece hood, or helmet or suit and operated in positive pressure mode.
Unknown concentration or Firefighting: Full facepiece, self-contained breathing apparatus operated in postive-pressure mode.

FIRST AID SOURCE: NIOSH
EYE: irr immed
SKIN: soap flush promptly
INHALATION: art resp
INGESTION: water, vomit

FIRST AID SOURCE: DOT Emergency Response Guide 1990.
Move victim to fresh air; call emergency medical care. In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes. Remove and isolate contaminated clothing and shoes at the site.

---------- INITIAL INCIDENT RESPONSE ----------

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: LEAD COMPOUNDS, SOLUBLE, N.O.S.
DOT ID NUMBER: UN2291

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POTENTIAL HAZARDS

*HEALTH HAZARDS
Poisonous if swallowed.
Inhalation of dust or mist may be poisonous.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.
*FIRE OR EXPLOSION
Some of these materials may burn, but none of them ignites readily.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry. Stay

upwind; keep out of low areas. Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC AT 1-800-424-9300. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk.
*SPILL OR LEAK
Do not touch or walk through spilled material; stop leak if you can do it without risk.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Small Dry Spills: With clean shovel place material into clean, dry container and cover loosely; move containers from spill area.
Large Spills: Dike far ahead of liquid spill for later disposal.
*FIRST AID
Move victim to fresh air; call emergency medical care. In case of contact with material, immediately flush skin or eyes with running water for at least 15 minutes. Remove and isolate contaminated clothing and shoes at the site.

CHEMTOX DATA

---------- IDENTIFIERS ----------

CHEMTOX RECORD 4731 LAST UPDATE OF THIS RECORD: 11/24/95
NAME: DIESEL FUEL
SYNONYMS: AUTOMOTIVE DIESEL OIL; DIESEL FUEL (DOT); DIESEL OIL (PETROLEUM); DIESEL OILS; DIESEL TEST FUEL; FUEL OIL, DIESEL (DOT); FUELS, DIESEL; NA 1993 (DOT); OLEJ NAPEDOWY III (Polish)
CAS: 68512-90-3 RTECS: HZ1800000
FORMULA: MOL WT:
WLN:
CHEMICAL CLASS:Aromatic hydrocarbon

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION: clear liquid
BOILING POINT: NA
MELTING POINT: NA
FLASH POINT: 322.15 K 49 C 120.2 F
AUTO IGNITION: Not available
VAPOR PRESSURE:
UEL: 7.5 %
LEL: 0.5 %
VAPOR DENSITY: > 4 (air=1)
SPECIFIC GRAVITY: 0.8
DENSITY: 0.8 g/cc or 7.44 lb/gal
WATER SOLUBILITY: NEGLIGIBLE
INCOMPATIBILITIES: strong oxidizers

REACTIVITY WITH WATER: No data on water reactivity
REACTIVITY WITH COMMON MATERIALS: No data
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: NIOSH has recommened that whole diesel exhaust be treated as an occupational carcinogen based on its effects on laboratory animals.
ODOR DETECTED AT (ppm): Unknown
ODOR DESCRIPTION: No data
100 % ODOR DETECTION: No data

---------- REGULATIONS ----------

DOT hazard class: 3 FLAMMABLE LIQUID
DOT guide: 27

Identification number: UN1993
DOT shipping name: FLAMMABLE LIQUIDS, N.O.S. (DIESEL FUEL)
Packing group: III
Label(s) required: FLAMMABL LIQUID
Special provisions: B1, B52, T7, T30
Packaging exceptions: 173.150
Non bulk packaging: 173.203
Bulk packaging: 173.242
Quantity limitations-
Passenger air/rail: 60 L
Cargo aircraft only: 220 L
Vessel stowage: A
Other stowage provisions:

STCC NUMBER: 4915113

CLEAN WATER ACT Sect.307:No
CLEAN WATER ACT Sect.311:No
CLEAN AIR ACT: Not listed
EPA WASTE NUMBER: D001
CERCLA REF:
RQ DESIGNATION: Not listed
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Acute toxicity: Irritant
Fire hazard: combustible.
Chronic toxicity: carcinogen

UNITED STATED POSTAL SERVICE MAILABILITY:
Not given

NFPA CODES:
HEALTH HAZARD (BLUE): (0) No unusual health hazard.
FLAMMABILITY (RED) : (2) This material must be moderately heated before ignition will occur.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON ----------

DIESEL FUEL [68512-90-3]
DOT Hazardous Materials Table. 49 CFR 172.101
EPA TSCA Chemical Inventory List 1989
EPA TSCA Test Submission (TSCATS) Database - April 1990
RCRA Hazardous Waste

---------- TOXICITY DATA ----------

SHORT TERM TOXICITY: Unknown

LONG TERM TOXICITY: unknown

TARGET ORGANS: eyes, skin

SYMPTOMS: Inhalation of mist or high concentrations of vapor can produce dizziness, headache, nausea, and possibly irritation of the eyes, nose and throat. Source:

CONC IDLH: Nonegiven

NIOSH REL: Not given

ACGIH TLV: Not listed
ACGIH STEL: Not listed

OSHA PEL: Not in Table Z-1-A

MAK INFORMATION: ppm

CARCINOGEN?: N STATUS: See below

CARCINOGEN LISTS:
IARC: Not listed
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

LD50 value: orl-rat LD50:9 gm/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:9 gm/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):
This chemical has no known mammalian reproductive toxicity.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)

California Prop 65: Not listed

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

wear protective gloves and clothing. eye protection such as safety glasses recommended.

FIRST AID SOURCE: DOT Emergency Response Guide 1990.
Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

---------- INITIAL INCIDENT RESPONSE ----------

FIRE EXTINGUISHMENT: DRY CHEMICAL, CARBON DIOXIDE, HALOGENATED AGENTS, FOAM. Note: CHRIS91

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: FLAMMABLE LIQUIDS, N.O.S. (DIESEL FUEL)
DOT ID NUMBER: UN1993

ERG93 GUIDE 27

POTENTIAL HAZARDS

*FIRE OR EXPLOSION
Flammable/combustible material; may be ignited by heat, sparks or flames.
Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.
Vapor explosion hazard indoors, outdoors or in sewers.
Runoff to sewer may create fire or explosion hazard.
Material may be transported hot.
*HEALTH HAZARDS
May be poisonous if inhaled or absorbed through skin.
Vapors may cause dizziness or suffocation.
Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind; keep out of low areas. Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection. *Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC AT 1-800-424-9300. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. For massive

fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.

*SPILL OR LEAK

Shut off ignition sources; no flares, smoking or flames in hazard area. Stop leak if you can do it without risk. Water spray may reduce vapor; but it may not prevent ignition in closed spaces.

Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.

Large Spills: Dike far ahead of liquid spill for later disposal.

*FIRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

CHEMTOX DATA

---------- IDENTIFIERS ----------

CHEMTOX RECORD 206 LAST UPDATE OF THIS RECORD: 11/24/95

NAME: ETHYL BENZENE

SYNONYMS: AETHYLBENZOL (German); EB; ETHYLBENZEEN (Dutch); ETHYL BENZENE; ETHYL BENZENE (DOT); ETHYLBENZOL; ETILBENZENE (Italian); ETYLOBENZEN (Polish); NCI-C56393; PHENYLETHANE

CAS: 100-41-4 RTECS: DA0700000

FORMULA: C8H10 MOL WT: 106.18

WLN: 2R

CHEMICAL CLASS: Aromatic hydrocarbon

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION: colorless liquid with a sweet, gasoline-like odor.

BOILING POINT:	409.2 K	136 C	276.8 F
MELTING POINT:	178.15 K	-95 C	-139 F
FLASH POINT:	285.93 K	12.78 C	55 F
AUTO IGNITION:	733 K	459.8 C	859.8 F
CRITICAL TEMP:	617.1 K	343.95 C	651.11 F
CRITICAL PRESS:	3.61 kN/M2	35.5 atm	523 psia
HEAT OF VAP:	144 Btu/lb	79.97 cal/g	3.346x E5 J/kg
HEAT OF COMB:	-17780 Btu/lb	-9885 cal/g	-413x E5 J/kg

VAPOR PRESSURE: 10mm @ 25.9 C

UEL: 6.7 %

LEL: 1.0 %

IONIZATION POTENTIAL (eV): 8.76

VAPOR DENSITY: 3.7 (air=1)

EVAPORATION RATE: 0.84(n-BUTYL ACETATE=1)

SPECIFIC GRAVITY: 0.867 20C

DENSITY: 0.866 g/mL @ 20 C

WATER SOLUBILITY: 0.015%

INCOMPATIBILITIES: strong oxidizers

REACTIVITY WITH WATER: No data on water reactivity

REACTIVITY WITH COMMON MATERIALS: OXIDIZING MATERIALS Source: SAX

STABILITY DURING TRANSPORT: No Data

NEUTRALIZING AGENTS: No data

POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: None reported other than possible unburned vapors

ODOR DETECTED AT (ppm): 140

ODOR DESCRIPTION: AROMATIC Source:CHRIS

100 % ODOR DETECTION: No data

---------- REGULATIONS ----------

DOT hazard class: 3 FLAMMABLE LIQUID
DOT guide: 26
Identification number: UN1175
DOT shipping name: Ethylbenzene
Packing group: II
Label(s) required: FLAMMABLE LIQUID
Special provisions: T1
Packaging exceptions: 173.150
Non bulk packaging: 173.202
Bulk packaging: 173.242
Quantity limitations-
Passenger air/rail: 5 L
Cargo aircraft only: 60 L
Vessel stowage: B
Other stowage provisions:

STCC NUMBER: 4909163

CLEAN WATER ACT Sect.307:Yes
CLEAN WATER ACT Sect.311:Yes
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 0.7 mg/L (07/30/92)
Maximum Contaminant Level Goals (MCLG): 0.7 mg/L (07/30/92)
CLEAN AIR ACT: CAA '90 Listed
EPA WASTE NUMBER: D001
CERCLA REF: Y
RQ DESIGNATION: C 1000 pounds (454 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Acute toxicity: Irritant
Acute toxicity: adverse effect to target organs.
Chronic toxicity: mutagen.
Chronic toxicity: reproductive toxin.
Fire hazard: flammable.
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 1.0 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: Flammable liquid - Mailable as ORM-D
Mailability: Domestic surface mail only
Max per parcel: 1 QT METAL; 1 PT OTHER

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON ----------

ACGIH TLV list "Threshold Limit Values for 1992-1993"
California Assembly Bill 1803 Well Monitoring Chemicals.
Canadian Domestic Substances List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
Clean Air Act Section 111 List.
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 307 Priority Pollutants
Clean Water Act Section 311 Hazardous Chemicals List.
DOT Hazardous Materials Table. 49 CFR 172.101
EPA Carcinogen Assessment Group List
EPA List of VOC chemicals from 40 CFR 60.489
EPA TSCA 8(a) Preliminary Assessment Information Rule - effective 11/19/82
EPA TSCA 8(d) Health and Safety Data Rule - effective date 06/19/87
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
ETHYL BENZENE [100-41-4]
Massachusetts Substance List.
New Jersey DEQ100 list for release reporting.
New Jersey Right To Know Substance List. (December 1987)
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
OSHA Process Safety Rule chemical with a TQ. Effective May 26, 1992
Pennsylvania Hazardous Substance List
RCRA Hazardous Constituents for Ground Water Monitoring. Ap'dx IX to 40 CFR 264
RCRA Hazardous Waste
SARA Section 313 Toxic Chemicals List
Superfund/CERCLA RQ list. Table 302.4 in 54 FR 50968 (December 11, 1989)
Wisconsin Air Toxics Control Regulation NR-445 (December 1988)

---------- TOXICITY DATA ----------

SHORT TERM TOXICITY: INHALATION: 200 ppm for 30 minutes can cause irritation of the nose and throat, dizziness, difficult breathing and depression. very high levels can cause unconsciousness. SKIN: can cause irritation, inflammation, blisters and burns. Eyes: 200 ppm can cause irritation. higher levels can cause burning, tearing and injury. INGESTION: can cause headache, sleepiness and coma.(NYDH)

LONG TERM TOXICITY: may cause skin rash and irritation of eyes, nose and throat.(NYDH)

TARGET ORGANS: eyes, upper resp sys, skin, CNS

SYMPTOMS: Inhalation may cause irritation of nose, dizziness,

depression. Moderate irritation of eye with corneal injury possible. Irritates skin and may cause blisters. Source: CHRIS

CONC IDLH: 800PPM

NIOSH REL:

ACGIH TLV: TLV = 100ppm(434 mg/M3)
ACGIH STEL: STEL = 125 ppm(543 mg/M3)

OSHA PEL: Transitional Limits:
PEL = 100 ppm(435mg/M3)
Final Rule Limits:
TWA = 100 ppm (435 mg/M3)
STEL = 125 ppm(545 mg/M3)

MAK INFORMATION: 100 ppm
440 mG/M3
Local irritant: Peak = 2xMAK for 5 minutes, 8 times per shift.
Danger of cutaneous absorption

CARCINOGEN?: N STATUS: See below

CARCINOGEN LISTS:
IARC: Not listed
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)
ihl-hmn TCLo:100 ppm/8H AIHAAP 31,206,70
SENSE ORGANS
Eye
Other
BEHAVIORAL
Sleep
LUNGS, THORAX, OR RESPIRATION
Other changes

LD50 value: orl-rat LD50:3500 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:3500 mg/kg
ihl-rat LCLo:4000 ppm/4H
ihl-mus LDLo:50 gm/m3/2H
ipr-mus LD50:2272 mg/kg
skn-rbt LD50:17800 mg/kg

ihl-gpg LCLo:10000 ppm

IRRITATION DATA: (Source: NIOSH RTECS 1992)

skn-rbt 15 mg/24H open MLD
eye-rbt 100 mg

Reproductive toxicity (1992 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)
ihl-rat TCLo:97 ppm/7H (15D pre) NTIS** PB83-208074
EFFECTS ON FERTILITY
Female fertility index

ihl-rat TCLo:985 ppm/7H (1-19D preg) NTIS** PB83-208074
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-rat TCLo:96 ppm/7H (1-19D preg) NTIS** PB83-208074
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:600 mg/m3/24H (7-15D preg) ATSUDG 8,425,85
EFFECTS ON FERTILITY
Post-implantation mortality
EFFECTS ON EMBRYO OR FETUS
Fetal death
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:2400 mg/m3/24H (7-15D preg) ATSUDG 8,425,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-rbt TCLo:99 ppm/7H (1-18D preg) NTIS** PB83-208074
EFFECTS ON FERTILITY
Litter size(# fetuses per litter;measured before birth)

ihl-rbt TCLo:500 mg/m3/24H (7-20D preg) ATSUDG 8,425,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

California Prop 65: Not listed

---------- EPA's IRIS DATA SUMMARY ----------
Ethylbenzene; CASRN 100-41-4 (04/01/92)

_II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Ethylbenzene
CASRN -- 100-41-4

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quantitative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

__II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

___II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- D; not classifiable as to human carcinogenicity.

Basis -- nonclassifiable due to lack of animal bioassays and human studies.

___II.A.2. HUMAN CARCINOGENICITY DATA

None.

___II.A.3. ANIMAL CARCINOGENICITY DATA

None. NTP has plans to initiate bioassay. Metabolism and excretion studies at 3.5, 35 and 350 mg/kg are to be conducted as well.

___II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

The metabolic pathways for humans and rodents are different (Engstrom et al., 1984). Major metabolites in humans, mandelic acid and phenylglyoxylic acid, are minor metabolites in rats and rabbits (Kiese and Lenk, 1974). The major animal metabolites were not detected in the urine of exposed workers (Engstrom et al., 1984).

Ethylbenzene at 0.4 mg/plate was not mutagenic for Salmonella strains TA98, TA1535, TA1537 and TA1538 with or without Aroclor 1254 induced rat

liver homogenates (S9) (Nestmann et al., 1980). Ethylbenzene was shown to increase the mean number of sister chromatid exchanges in human whole blood lymphocyte culture at the highest dose examined without any metabolic activation system (Norppa and Vainio, 1983).

Dean et al. (1985) used a battery of short-term tests including bacterial mutation assays, mitotic gene conversion in Saccharomyces cerevisiae JD1 in the presence and absence of S9 and chromosomal damage in a cultured rat liver cell line. Ethylbenzene was not mutagenic in the range of concentrations tested (0.2, 2, 20, 50 and 200 ug/plate) for S. typhimurium TA98, TA100, TA1535, TA1537 and TA1538 or for Escherichia coli WP2 and WP2uvrA. Ethylbenzene also showed no response in the S. cerevisiae JD1 gene conversion assay. In contrast, ethylbenzene hydroperoxide showed positive responses with E. coli WP2 at 200 ug/plate in the presence of S9 and an equally significant response with the gene conversion system of yeast.

__II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

Not available.

__II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

Not available.

__II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

___II.D.1. EPA DOCUMENTATION

U.S. EPA. 1980. Ambient Water Quality Criteria Document for Ethylbenzene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Water Regulations and Standards, Washington, DC. EPA 440/5-80-048. NTIS PB 81-117590.

U.S. EPA. 1984. Health Effects Assessment for Ethylbenzene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Emergency and Remedial Response, Washington, DC. EPA/540/1-86/008.

U.S. EPA. 1987. Drinking Water Criteria Document for Ethylbenzene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Drinking Water, Washington, DC.

___II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The Ambient Water Quality Criteria Document and the Health Assessment Document have received Agency and external review. The Drinking Water Criteria Document has been extensively reviewed.

Agency Work Group Review: 10/07/87

Verification Date: 10/07/87

___II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

Arthur S. Chiu / ORD -- (202)260-6764 / FTS 260-6764

Lynn Papa / ORD -- (513)569-7523 / FTS 684-7523

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:
self-contained breathing apparatus; safety goggles.

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly when skin becomes contaminated.

** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammability

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
OSHA (ETHYL BENZENE)
1000 ppm: Any powered air-purifying respirator with organic vapor

cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any supplied-air respirator. * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus. * Substance reported to cause eye irritation or damage may require eye protection. / Any chemical cartridge respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection.
2000 ppm: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any supplied-air respirator with a full facepiece. / Any self-contained breathing apparatus with a full facepiece.
EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.: Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID SOURCE: CHRIS Manual 1991
INHALATION: if ill effects occur, remove victim to fresh air, keep him warm and quiet, and get medical help promptly; if breathing stops, give artificial respiration.
INGESTION: induce vomiting only upon physician's approval; material in lung may cause chemical pneumonitis.
SKIN AND
EYES: promptly flush with plenty of water (15 min. for eyes) and get medical attention; remove and wash contaminated clothing before reuse.

FIRST AID SOURCE: DOT Emergency Response Guide 1990.
Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

---------- INITIAL INCIDENT RESPONSE ----------

FIRE EXTINGUISHMENT: Foam (most effective), water fog, carbon dioxide or dry chemical. CHRIS91

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: Ethylbenzene
DOT ID NUMBER: UN1175

ERG93 GUIDE 26

POTENTIAL HAZARDS

*FIRE OR EXPLOSION
Flammable/combustible material; may be ignited by heat, sparks or flames.

Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.
Vapor explosion hazard indoors, outdoors or in sewers.
Runoff to sewer may create fire or explosion hazard.
*HEALTH HAZARDS
May be poisonous if inhaled or absorbed through skin.
Vapors may cause dizziness or suffocation.
Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may give off poisonous gases and cause water pollution.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry.
Stay upwind; keep out of low areas. Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection. *Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC AT 1-800-424-9300. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO2, water spray or alcohol-resistant foam. Do not use dry chemical extinguishers to control fires involving nitromethane or nitroethane. Large Fires: Water spray, fog or alcohol-resistant foam. Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.
*SPILL OR LEAK
Shut off ignition sources; no flares, smoking or flames in hazard area.
Stop leak if you can do it without risk.
Water spray may reduce vapor; but it may not prevent ignition in closed spaces.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.
*FIRST AID
Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

or omissions within this database, or in any of its printed or displayed output forms.

CHEMTOX DATA

---------- IDENTIFIERS ----------

CHEMTOX RECORD 421 LAST UPDATE OF THIS RECORD: 11/24/95

NAME:	XYLENE
SYNONYMS:	XYLENE (XYLOL); XYLOL; METHYL TOLUENE; BENZENE, DIMETHYL-; DIMETHYLBENZENE; NCI-C55232; VIOLET 3; XYLOL (DOT); SOCAL AQUATIC SOLVENT 3501
CAS:	1330-20-7 RTECS: ZE2100000
FORMULA:	C8H10 MOL WT: 106.18
WLN:	1R X1
CHEMICAL CLASS:	Aromatic hydrocarbon

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION:	colorless liquid with aromatic odor		
BOILING POINT:	412 K	138.8 C	281.9 F
MELTING POINT:	247 K	-26.2 C	-15.1 F
FLASH POINT:	300.35-305.35 K	27.2-32.2 C	80.9-89.9 F
AUTO IGNITION:	736.45-802.05 K	463.3-528.9 C	866-984.1 F
VAPOR PRESSURE:	6.7 mm @ 21 C		
UEL:	7 %		
LEL:	1 %		
IONIZATION POTENTIAL (eV):	8.56		
VAPOR DENSITY:	3.7 (air=1)		
EVAPORATION RATE:	0.77(n-BUTYL ACETATE=1)		
SPECIFIC GRAVITY:	0.861 20C		
DENSITY:	0.861 g/cc or 8.0073 lb/gal		
WATER SOLUBILITY:	VERY SL SOL		
INCOMPATIBILITIES:	strong oxidizers		
REACTIVITY WITH WATER:	No data on water reactivity		
REACTIVITY WITH COMMON MATERIALS:	No data		
STABILITY DURING TRANSPORT:	No Data		
NEUTRALIZING AGENTS:	No data		
POLYMERIZATION POSSIBILITIES:	No data		
TOXIC FIRE GASES:	None reported other than possible unburned vapors		
ODOR DETECTED AT (ppm):	0.05		
ODOR DESCRIPTION:	LIKE BENZENE; CHARACTERISTIC AROMATIC Source:CHRIS		
100 % ODOR DETECTION:	0.4-20 ppm		

---------- REGULATIONS ----------

DOT hazard class:	3 FLAMMABLE LIQUID
DOT guide:	27

Identification number: UN1307
DOT shipping name: XYLENES
Packing group: II
Label(s) required: FLAMMABLE LIQUID
Special provisions: T1
Packaging exceptions: 173.150
Non bulk packaging: 173.202
Bulk packaging: 173.242
Quantity limitations-
Passenger air/rail: 5 L
Cargo aircraft only: 60 L
Vessel stowage: B
Other stowage provisions:

STCC NUMBER: 4909350, 4909351

CLEAN WATER ACT Sect.307:No
CLEAN WATER ACT Sect.311:Yes
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 10 mg/L (07/30/92)
Maximum Contaminant Level Goals (MCLG): 10 mg/L (07/30/92)
CLEAN AIR ACT: CAA '90 Listed
EPA WASTE NUMBER: U239,D001
CERCLA REF: Not listed
RQ DESIGNATION: B 100 pounds (45.4 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312
categories:
Acute toxicity: Irritant
Acute toxicity: adverse effect to target organs.
Chronic toxicity: adverse effect to target organ after long period of exposure.
Chronic toxicity: reproductive toxin.
Fire hazard: flammable.
Chronic toxicity: carcinogen
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 1.0 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: Not given
Mailability: Nonmailable
Max per parcel: 0

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON ----------

ACGIH TLV list "Threshold Limit Values for 1992-1993"
California Assembly Bill 1803 Well Monitoring Chemicals.
Canadian Domestic Substances List
Clean Air Act Section 111 List.
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 311 Hazardous Chemicals List.
DOT Hazardous Materials Table. 49 CFR 172.101
EPA List of VOC chemicals from 40 CFR 60.489
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
Massachusetts Substance List.
New Jersey DEQ100 list for release reporting.
New Jersey Right To Know Substance List. (December 1987)
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
OSHA Process Safety Rule chemical with a TQ. Effective May 26, 1992
Pennsylvania Hazardous Substance List
RCRA Hazardous Constituents for Ground Water Monitoring. Ap'dx IX to 40 CFR 264
RCRA Hazardous Waste
SARA Section 110 Priority List of CERCLA Hazardous Substances
SARA Section 313 Toxic Chemicals List
Superfund/CERCLA RQ list. Table 302.4 in 54 FR 50968 (December 11, 1989)
Washington State Discarded Chemical Products List, November 17, 1989
Wisconsin Air Toxics Control Regulation NR-445 (December 1988)
XYLENE [1330-20-7]

---------- TOXICITY DATA ----------

SHORT TERM TOXICITY: Unknown

LONG TERM TOXICITY: unknown

TARGET ORGANS: CNS, eyes, gi tract, blood, liver, kidneys, skin

SYMPTOMS: DIZZ, EXCITEMENT, DROW, INCO, STAGGERING GAIT, IRRIT EYES, NOSE, THROAT, CORNEAL VACUOLIZATION, ANOREXIA, NAU, VOMIT, ABDOM PAIN; DERM Source: CHRIS

CONC IDLH: 1000ppm

NIOSH REL: 100 ppm Time weighted averages for 8-hour exposure 434 mg/M3 Time weighted averages for 8-hour exposure 200 ppm Ceiling exposures which shall at no time be exceeded(10-MIN) 868 mg/M3 Ceiling exposures which shall at no time be exceeded(10-MIN)

ACGIH TLV: TLV = 100ppm(434 mg/M3)

ACGIH STEL: STEL = 150 ppm(651 mg/M3)

OSHA PEL: Transitional Limits:
PEL = 100 ppm(435mg/M3)
Final Rule Limits:
TWA = 100 ppm (435 mg/M3)
STEL = 150 ppm(655 mg/M3)

MAK INFORMATION: 100 ppm
440 mG/M3
Substance with systemic effects, onset of effect less than or equal to 2 hrs: Peak = 2xMAK for 30 minutes, 4 times per shift of 8 hours.

CARCINOGEN?: N STATUS: See below

CARCINOGEN LISTS:
IARC: Not classified as to human carcinogenicity or probably not carcinogenic to humans.
MAK: Not listed
NIOSH: Not listed
NTP: Not listed
ACGIH: Not listed
OSHA: Not listed

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)
* orl-hmn LDLo:50 mg/kg YAKUD5 22,883,80

ihl-man LCLo:10000 ppm/6H BMJOAE 3,442,70
BEHAVIORAL
General anesthetic
LUNGS, THORAX, OR RESPIRATION
Cyanosis
BLOOD
Other changes

LD50 value: orl-rat LD50:4300 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:4300 mg/kg
ihl-rat LC50:5000 ppm/4H
ipr-rat LD50:2459 mg/kg
scu-rat LD50:1700 mg/kg
ipr-mus LD50:1548 mg/kg
ivn-rbt LDLo:129 mg/kg
ihl-gpg LCLo:450 ppm
ipr-gpg LDLo:2 gm/kg
ipr-mam LDLo:2 gm/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)
ihl-rat TCLo:250 mg/m3/24H (7-15D preg) ATSUDG 8,425,85
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rat TCLo:50 mg/m3/6H (1-21D preg) JHEMA2 27,337,83
EFFECTS ON FERTILITY
Post-implantation mortality
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Craniofacial(including nose and tongue)

ihl-rat TCLo:50 mg/m3/6H (1-21D preg) JHEMA2 27,337,83
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Other developmental abnormalities
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)

ihl-rat TCLo:600 mg/m3/24H (7-15D preg) PCBRD2
163B,295,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

orl-mus TDLo:20600 ug/kg (6-15D preg) JTEHD6 9,97,82
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Craniofacial(including nose and tongue)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

orl-mus TDLo:31 mg/kg (6-15D preg) JTEHD6 9,97,82
EFFECTS ON FERTILITY
Post-implantation mortality

ihl-mus TCLo:4000 ppm/6H (6-12D preg) TJADAB 28,22A,83
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)
EFFECTS ON NEWBORN
Physical

ihl-mus TCLo:2000 ppm/6H (6-12D preg) TJADAB 28,22A,83
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-mus TCLo:1 gm/m3/12H (6-15D preg) ATSUDG 8,425,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-rbt TCLo:500 mg/m3/24H (7-20D preg) ATSUDG 8,425,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

California Prop 65: Not listed

---------- EPA's IRIS DATA SUMMARY ----------

Xylenes; CASRN 1330-20-7 (04/01/92)

_II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Xylenes
CASRN -- 1330-20-7
Last Revised -- 03/01/91

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quantitative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

__II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

___II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- D; not classifiable as to human carcinogenicity.

Basis -- Orally administered technical xylene mixtures did not result in significant increases in incidences in tumor responses in rats or mice of both sexes.

___II.A.2. HUMAN CARCINOGENICITY DATA

None.

II.A.3. ANIMAL CARCINOGENICITY DATA

Inadequate. In an NTP (1986) study, 50 male and 50 female F344/N rats were treated by gavage with mixed xylenes in corn oil (60% m-xylene, 14% p-xylene, 9% o-xylene and 17% ethylbenzene) at dosages of 0, 250 or 500 mg/kg/day, 5 days/week for 103 weeks. Similarly, 50 male and 50 female B6C3F1 mice were treated with the same xylene mixture at dosages of 0, 500 or 1000 mg/kg/day. Animals were killed and examined histologically when moribund or after 104-105 weeks. An apparent dose-related increased mortality was observed in male rats, but this difference was statistically significant for the high dose group, only. No other differences in survival between dosage groups of either sex were observed. Interstitial cell tumors of the testes could not be attributed to administration of the test compound observed in male rats (43/50 control, 38/50 low-dose and 41/49 high-dose). NTP (1986) reported that there were no significant changes in the incidence of neoplastic or nonneoplastic lesions in either the rats or mice that could be considered related to the mixed xylene treatment, and concluded that under the conditions of these 2-year gavage studies, there was "no evidence of carcinogenicity" of xylene (mixed) for rats or mice of either sex at any dosage tested.

Maltoni et al. (1985), in a limited study, reported higher incidences (compared with controls) of malignant tumors in male and female Sprague-Dawley rats treated by gavage with xylene in olive oil at 500 mg/kg/day, 4 or 5 days/week for 104 weeks. This study did not report survival rates or specific tumor types; therefore, the results cannot be interpreted.

Berenblum (1941) reported that "undiluted" xylene applied at weekly intervals produced one tumor-bearing animal out of 40 after 25 weeks in skin-painting experiments in mice. No control groups were described. Pound (1970) reported negative results in initiation-promotion experiments with xylene as the initiator and croton oil as the promotor.

II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

The frequency of sister chromatid exchanges and chromosomal aberrations were nearly identical between a group of 17 paint industry workers exposed to xylene and their respective referents (Haglund et al., 1980). In vitro, xylene caused no increase in the number of sister chromatid exchanges in human lymphocytes (Gerner-Smidt and Friedrich, 1978). Studies indicate that xylene isomers, technical grade xylene or mixed xylene are not mutagenic in tests with Salmonella typhimurium (Florin et al., 1980; NTP, 1986; Bos et al., 1981) nor in mutant reversion assays with Escherichia coli (McCarroll et al., 1981). Technical grade xylene, but not o- and m-xylene, was weakly mutagenic in Drosophila recessive lethal tests. Chromosomal aberrations were not increased in bone marrow cells of rats exposed to xylenes by inhalation (Donner et al., 1980).

__II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

Not available.

__II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

Not available.

__II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

___II.D.1. EPA DOCUMENTATION

U.S. EPA. 1987. Drinking Water Criteria Document for Xylene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Drinking Water, Washington, DC. ECAO-CIN-416. Final.

___II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The Drinking Water Criteria Document for Xylene has received Agency and external review.

Agency Work Group Review: 12/02/87

Verification Date: 12/02/87

___II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

Bruce Mintz / ODW -- (202)260-9569 / FTS 260-9569

W. Bruce Peirano / ORD -- (513)569-7540 / FTS 684-7540

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly when skin becomes contaminated.

** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammability

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
NIOSH (XYLENE)
1000 ppm: Any chemical cartridge respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any powered air-purifying respirator with organic vapor cartridge(s). * Substance reported to cause eye irritation or damage may require eye protection. / Any supplied-air respirator. * Substance reported to cause eye irritation or damage may require eye protection. / Any self-contained breathing apparatus. * Substance reported to cause eye irritation or damage may require eye protection.
EMERGENCY OR PLANNED ENTRY IN UNKNOWN CONCENTRATIONS OR IDLH CONDITIONS.: Any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode. / Any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
ESCAPE: Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister. / Any appropriate escape-type self-contained breathing apparatus.

FIRST AID SOURCE: NIOSH
EYE: irr immed
SKIN: soap wash promptly
INHALATION: art resp
INGESTION: no vomit

FIRST AID SOURCE: DOT Emergency Response Guide 1990.
Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with

running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

---------- INITIAL INCIDENT RESPONSE ----------

US Department of Transportation Guide to Hazardous Materials Transport Information - Publication DOT 5800.5 (1990).
DOT SHIPPING NAME: XYLENES
DOT ID NUMBER: UN1307

ERG93 GUIDE 27

POTENTIAL HAZARDS

*FIRE OR EXPLOSION
Flammable/combustible material; may be ignited by heat, sparks or flames.
Vapors may travel to a source of ignition and flash back.
Container may explode in heat of fire.
Vapor explosion hazard indoors, outdoors or in sewers.
Runoff to sewer may create fire or explosion hazard.
Material may be transported hot.
*HEALTH HAZARDS
May be poisonous if inhaled or absorbed through skin.
Vapors may cause dizziness or suffocation.
Contact may irritate or burn skin and eyes.
Fire may produce irritating or poisonous gases.
Runoff from fire control or dilution water may cause pollution.

EMERGENCY ACTION

Keep unnecessary people away; isolate hazard area and deny entry. Stay upwind; keep out of low areas. Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide limited protection. *Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire. CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC AT 1-800-424-9300. If water pollution occurs, notify the appropriate authorities.
*FIRE
Small Fires: Dry chemical, CO2, water spray or regular foam.
Large Fires: Water spray, fog or regular foam.
Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire burn. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire.
*SPILL OR LEAK
Shut off ignition sources; no flares, smoking or flames in hazard area. Stop leak if you can do it without risk. Water spray may reduce vapor; but it may not prevent ignition in closed spaces.
Small Spills: Take up with sand or other noncombustible absorbent material and place into containers for later disposal.
Large Spills: Dike far ahead of liquid spill for later disposal.
*FIRST AID

Move victim to fresh air and call emergency medical care; if not breathing, give artificial respiration; if breathing is difficult, give oxygen. In case of contact with material, immediately flush eyes with running water for at least 15 minutes. Wash skin with soap and water. Remove and isolate contaminated clothing and shoes at the site.

CHEMTOX DATA

---------- IDENTIFIERS ----------

CHEMTOX RECORD 59 LAST UPDATE OF THIS RECORD: 11/24/95
NAME: BENZENE
SYNONYMS: BENZOL; CYCLOHEXATRIENE; PHENYL HYDRIDE; PHENE; COAL NAPHTHA; PYROBENZOL
CAS: 71-43-2 RTECS: CY1400000
FORMULA: C6H6 MOL WT: 78.11
WLN: RH
CHEMICAL CLASS: Aromatic hydrocarbon

See other identifiers listed below under Regulations.

---------- PROPERTIES ----------

PHYSICAL DESCRIPTION: colorless to pale yellow watery liquid with a gasoline-like odor

BOILING POINT:	353.15 K	80 C	176 F
MELTING POINT:	278.71 K	5.5 C	42 F
FLASH POINT:	262 K	-11.15 C	11.9 F
AUTO IGNITION:	864.8 K	591.6 C	1097 F
CRITICAL TEMP:	562.1 K	288.95 C	552.11 F
CRITICAL PRESS:	4.89 kN/M2	48.2 atm	708 psia
HEAT OF VAP:	169 Btu/lb	93.85 cal/g	3.927x E5 J/kg
HEAT OF COMB:	-17460 Btu/lb	-9707 cal/g	-406x E5 J/kg

VAPOR PRESSURE: 75 mm @ 20 C
UEL: 7.1 %
LEL: 1.3 %
IONIZATION POTENTIAL (eV): 9.25
VAPOR DENSITY: 2.77 (air=1)
EVAPORATION RATE: 3.50(n-BUTYL ACETATE=1)
SPECIFIC GRAVITY: 0.86-0.88 20 C
DENSITY: 0.8794 @ 20 C
WATER SOLUBILITY: 0.06%
INCOMPATIBILITIES: strong ox,chlorine,bromine with iron; many fluorides and perchlorates, nitric acid

REACTIVITY WITH WATER: No data on water reactivity
REACTIVITY WITH COMMON MATERIALS: OXIDIZING MATERIALS(Br2, F2, CL2, CrO3, NaClO4, O2, O3), PERCHLORATES (AlCl3 +NaClO4), (H2SO4 & PERMANGANATES), K2O2, (AgClO4 & ACETIC ACID), Na2O2
Source: SAX
STABILITY DURING TRANSPORT: No Data
NEUTRALIZING AGENTS: No data
POLYMERIZATION POSSIBILITIES: No data

TOXIC FIRE GASES: VAPOR IS HEAVIER THAN AIR AND MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE

OF IGNITION AND FLASH BACK.

ODOR DETECTED AT (ppm): 4.68 ppm
ODOR DESCRIPTION: odor; characteristic odor Source:CHRIS
100 % ODOR DETECTION: No data

---------- REGULATIONS ----------

DOT hazard class: 3 FLAMMABLE LIQUID
DOT guide: 27
Identification number: UN1114
DOT shipping name: Benzene
Packing group: II
Label(s) required: FLAMMABLE LIQUID
Special provisions: T8
Packaging exceptions: 173.150
Non bulk packaging: 173.202
Bulk packaging: 173.242
Quantity limitations-
Passenger air/rail: 5 L
Cargo aircraft only: 60 L
Vessel stowage: B
Other stowage provisions: 40

STCC NUMBER: 4908110

CLEAN WATER ACT Sect.307: Yes
CLEAN WATER ACT Sect.311: Yes
National Primary Drinking Water Regulations
Maximum Contaminant Levels (MCL): 0.005 mg/L (01/09/89)
Maximum Contaminant Level Goals (MCLG): 0 mg/L (01/09/89)
CLEAN AIR ACT: CAA '90 Listed and CAA '77 Sect 109
EPA WASTE NUMBER: U019,D018,D001
CERCLA REF: Y
RQ DESIGNATION: A 10 pounds (4.54 kg) CERCLA
SARA TPQ VALUE: Not listed
SARA Sect. 312 categories:
Acute toxicity: Irritant
Acute toxicity: adverse effect to target organs.
Chronic toxicity: carcinogen
Chronic toxicity: mutagen.
Chronic toxicity: reproductive toxin.
Fire hazard: flammable.
LISTED IN SARA Sect 313: Yes
de minimus CONCENTRATION: 0.1 percent

UNITED STATED POSTAL SERVICE MAILABILITY:
Hazard class: Not given
Mailability: Nonmailable
Max per parcel: 0

NFPA CODES:
HEALTH HAZARD (BLUE): (2) Hazardous to health. Area may be entered with self-contained breathing apparatus.
FLAMMABILITY (RED) : (3) This material can be ignited under almost all temperature conditions.
REACTIVITY (YELLOW): (0) Stable even under fire conditions.
SPECIAL : Unspecified

---------- SUMMARY OF REGULATORY LISTS THIS SUBSTANCE APPEARS ON ----------

ACGIH TLV list "Threshold Limit Values for 1992-1993"
ATSDR Toxicology Profile available (NTIS** PB/89/209464/AS)
BENZENE [71-43-2]
California OSHA Carcinogens List.
California Assembly Bill 1803 Well Monitoring Chemicals.
California Assembly Bill 2588 Air Toxics "Hot Spots" Chemicals.
California Assembly Bill 1807 Toxic Air Contaminants.
Canadian Domestic Substances List
Canadian Ingredient Disclosure List. 20/01/88 Canada Gazette part II, Vol 122.
Clean Air Act Section 111 List.
Clean Air Act Section 112 Hazardous Air Pollutants List.
Clean Air Act of November 15, 1990. List of pollutants.
Clean Water Act Section 307 Priority Pollutants
Clean Water Act Section 311 Hazardous Chemicals List.
DOT Hazardous Materials Table. 49 CFR 172.101
DOT Marine Pollutant. Proposed list. 57 FR 3854, Jan 31, 1992
EPA Carcinogen Assessment Group List
EPA List of VOC chemicals from 40 CFR 60.489
EPA TSCA Chemical Inventory List 1986
EPA TSCA Chemical Inventory List 1989
EPA TSCA Chemical Inventory List 1990
EPA TSCA Chemical Inventory List 1992
EPA TSCA Test Submission (TSCATS) Database - April 1990
EPA TSCA Test Submission (TSCATS) Database - September 1989
Massachusetts Substance List.
National Toxicology Program (NTP) list of human carcinogens
New Jersey Right To Know Substance List. (December 1987)
New Jersey Right to Know Substance List. Listed as a carcinogen.
New Jersey Right to Know Substance List. Listed as a mutagen.
OSHA Air Contaminant (Table Z-1-A). 54 FR 4332, Jan. 19, 1989 and revised.
OSHA Process Safety Rule chemical with a TQ. Effective May 26, 1992
OSHA Specifically regulated substance. See 29 CFR 1910.1028
Pennsylvania Hazardous Substance List
RCRA Hazardous Constituents for Ground Water Monitoring. Ap'dx IX to 40 CFR 264
RCRA Hazardous Waste
RCRA Toxicity Characteristics (TC) list dated March 29, 1990
SARA Section 313 Toxic Chemicals List
Superfund/CERCLA RQ list. Table 302.4 in 54 FR 50968 (December 11, 1989)
Suspected carcinogen (ACGIH). "Threshold Limit Values for 1992-1993"
Washington State Discarded Chemical Products List, November 17, 1989
Wisconsin Air Toxics Control Regulation NR-445 (December 1988)

TOXICITY DATA

SHORT TERM TOXICITY: INHALATION: benzene may produce both nerve and blood effects. irritation of the nose, throat and lungs may occur (3,000 ppm may be tolerated for only 30 to 60 minutes). lung congestion may occur. nerve effects may include an exaggerated feeling of well-being, excitement, headache, dizziness and slurred speech. at high levels, slowed breathing and death may result. death has occurred at 20,000 ppm for 5 to 10 minutes, or 7,500 ppm for 30 minutes. SKIN: irritation may occur, with redness and blistering if not promptly removed. benzene is poorly absorbed. whole body exposure for 30 minutes has been reported with no health effects. Eyes: may cause severe irritation. INGESTION: may cause irritation of mouth, throat and stomach. symptoms are similar to those listed under inhalation. one tablespoon may cause collapse, bronchitis, pneumonia and death.(NYDH)

LONG TERM TOXICITY: may cause loss of appetite, nausea, weight loss, fatigue, muscle weakness, headache, dizziness, nervousness and irritability. mild anemia has been reported from exposures of 25 ppm for several years and 100 ppm for 3 months. at levels between 100 and 200 ppm for periods of 6 months, or more, severe irreversible blood changes and damage to liver and heart may occur. temporary partial paralysis has been reported.(NYDH)

TARGET ORGANS: blood, CNS, skin, bone marrow, eyes, resp sys, skin [leukemia]

SYMPTOMS: Dizziness, excitation, pallor, followed by flushing, weakness, headache, breathlessness, chest constriction. Coma and possible death. Source: CHRIS

CONC IDLH: 500ppm

NIOSH REL: Potential occupational carcinogen 0.1 ppm Time weighted averages for 8-hour exposure 0.32 mg/M3 Time weighted averages for 8-hour exposure 1 ppm Ceiling exposures which shall at no time be exceeded 3.2 mg/M3 Ceiling exposures which shall at no time be exceeded

ACGIH TLV: TLV = 10ppm Suspected human carcinogen (A2)
ACGIH STEL: Suspected human carcinogen (A2)

OSHA PEL: Final Rule Limits:
TWA = 1 ppm
STEL = 5 ppm
CONSULT 29CFR 1910.1028

MAK INFORMATION: Danger of cutaneous absorption
Carcinogenic working material without MAK
Capable of inducing malignant tumors as shown by experience with humans.

CARCINOGEN?: Y STATUS: See below
REFERENCES:

HUMAN SUSPECTED IARC** 7,203,74
HUMAN SUSPECTED IARC** 28,151,82
ANIMAL SUSPECTED IARC** 28,151,82
ANIMAL SUSPECTED IARC** 29,93,82
HUMAN POSITIVE IARC** 29,93,82
ANIMAL INDEFINITE IARC** 7,203,74

CARCINOGEN LISTS:

IARC: Carcinogen as defined by IARC as carcinogenic to humans, with sufficient epidemiological evidence.
MAK: Capable of inducing malignant tumors as shown by experience in humans.
NIOSH: Carcinogen defined by NIOSH with no further categorization.
NTP: Carcinogen defined by NTP as known to be carcinogenic, with evidence from human studies.
ACGIH: Carcinogen defined by ACGIH TLV Committee as a suspected carcinogen, based on either limited epidemological evidence or demonstration of carcinogenicity in experimental animals.
OSHA: Cancer hazard

HUMAN TOXICITY DATA: (Source: NIOSH RTECS)

* ihl-hmn LCLo:2 pph/5M TABIA2 3,231,33

* orl-man LDLo:50 mg/kg YAKUD5 22,883,80

* ihl-hmn LCLo:2000 ppm/5M YAKUD5 22,883,80

ihl-man TCLo:150 ppm/1Y-I BLUTA9 28,293,74
BLOOD
Other changes
NUTRITIONAL AND GROSS METABOLIC
Changes in:
Body temperature increase

ihl-hmn TCLo:100 ppm INMEAF 17,199,48
BEHAVIORAL
Somnolence(general depressed activity)

GASTROINTESTINAL
Nausea or vomiting
SKIN AND APPENDAGES
Skin - after systemic exposure
Dermatitis,other

ihl-hmn LCLo:65 mg/m3/5Y ARGEAR 44,145,74
BLOOD
Other changes

LD50 value: orl-rat LD50:930 mg/ kg

OTHER SPECIES TOXICITY DATA: (Source: NIOSH RTECS 1992)

orl-rat LD50:930 mg/kg
ihl-rat LC50:10000 ppm/7H
ipr-rat LD50:2890 ug/kg
orl-mus LD50:4700 mg/kg
ihl-mus LC50:9980 ppm
ipr-mus LD50:340 mg/kg
orl-dog LDLo:2 gm/kg
ihl-dog LCLo:146000 mg/m3
ihl-cat LCLo:170000 mg/m3
ihl-rbt LCLo:45000 ppm/30M
skn-rbt LD50:>9400 mg/kg
ivn-rbt LDLo:88 mg/kg
skn-gpg LD50:>9400 mg/kg
ipr-gpg LDLo:527 mg/kg
scu-frg LDLo:1400 mg/kg
ihl-mam LCLo:20000 ppm/5M
ipr-mam LDLo:1500 mg/kg

IRRITATION DATA: (Source: NIOSH RTECS 1992)

Reproductive toxicity (1992 RTECS):
This chemical is a mammalian reproductive toxin.

REPRODUCTIVE TOXICITY DATA (1992 RTECS)
ihl-rat TCLo:670 mg/m3/24H (15D pre/1-22D preg) HYSAAV 33(1-3),327,68
EFFECTS ON FERTILITY
Female fertility index

ihl-rat TCLo:56600 ug/m3/24H (1-22D preg) HYSAAV 33(7-9),112,68
EFFECTS ON NEWBORN

ihl-rat TCLo:50 ppm/24H (7-14D preg) JHEMA2 24,363,80
EFFECTS ON EMBRYO OR FETUS
Extra embryonic features(e.g.,placenta,umbilical cord)

EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

ihl-rat TCLo:150 ppm/24H (7-14D preg) JHEMA2 24,363,80
EFFECTS ON FERTILITY
Post-implantation mortality
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

orl-mus TDLo:9 gm/kg (6-15D preg) TJADAB 19,41A,79
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)

orl-mus TDLo:12 gm/kg (6-15D preg) TJADAB 19,41A,79
EFFECTS ON FERTILITY
Post-implantation mortality

orl-mus TDLo:6500 mg/kg (8-12D preg) TCMUD8 6,361,86
EFFECTS ON NEWBORN
Growth statistics(e.g.,reduced weight gain)

ihl-mus TCLo:500 ppm/7H (6-15D preg) AIHAAP 40,993,79
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-mus TCLo:500 mg/m3/12H (6-15D preg) ATSUDG 8,425,85
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ihl-mus TCLo:5 ppm (6-15D preg) TXCYAC 42,171,86
EFFECTS ON EMBRYO OR FETUS
Cytological changes(including somatic cell genetic material)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Blood and lymphatic systems(including spleen and marrow)

ihl-mus TCLo:20 ppm/6H (6-15D preg) FAATDF 10,224,88
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Blood and lymphatic systems(including spleen and marrow)

ipr-mus TDLo:5 mg/kg (1D male) TPKVAL 15,30,79
EFFECTS ON FERTILITY
Pre-implantation mortility
EFFECTS ON EMBRYO OR FETUS
Fetal death

ipr-mus TDLo:219 mg/kg (14D preg) EMMUEG 18,1,91

SPECIFIC DEVELOPMENTAL ABNORMALITIES
Blood and lymphatic systems(including spleen and marrow)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Hapatobilinary system

scu-mus TDLo:1100 mg/kg (12D preg) TOXID9 1,125,81
EFFECTS ON EMBRYO OR FETUS
Other effects on embryo or fetus

scu-mus TDLo:7030 mg/kg (12-13D preg) SEIJBO 15,47,75
EFFECTS ON EMBRYO OR FETUS
Extra embryonic features(e.g.,placenta,umbilical cord)
EFFECTS ON EMBRYO OR FETUS
Fetotoxicity(except death,e.g.,stunted fetus)
SPECIFIC DEVELOPMENTAL ABNORMALITIES
Musculoskeletal system

ivn-mus TDLo:13200 ug/kg (13-16D preg) ICHUDW 4(6),24,82
EFFECTS ON EMBRYO OR FETUS
Cytological changes(including somatic cell genetic material)

par-mus TDLo:4 gm/kg (12D preg) NEZAAQ 25,438,70
EFFECTS ON NEWBORN
Weaning or lactation index(#alive at weaning per # alive at day 4)

ihl-rbt TCLo:1 gm/m3/24H (7-20D preg) ATSUDG 8,425,85
EFFECTS ON FERTILITY
Post-implantation mortality
EFFECTS ON FERTILITY
Abortion
EFFECTS ON EMBRYO OR FETUS
Fetal death

California Prop 65: Carcinogen (02/27/87)
No significant risk level 7. ugD (01/01/94)

---------- EPA's IRIS DATA SUMMARY ----------
Benzene; CASRN 71-43-2 (04/01/92)

_II. CARCINOGENICITY ASSESSMENT FOR LIFETIME EXPOSURE

Substance Name -- Benzene
CASRN -- 71-43-2
Last Revised -- 04/01/92

Section II provides information on three aspects of the carcinogenic risk assessment for the agent in question; the U.S. EPA classification, and quant-

itative estimates of risk from oral exposure and from inhalation exposure. The classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in three ways. The slope factor is the result of application of a low-dose extrapolation procedure and is presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per ug/L drinking water or risk per ug/cu.m air breathed. The third form in which risk is presented is a drinking water or air concentration providing cancer risks of 1 in 10,000, 1 in 100,000 or 1 in 1,000,000. Background Document 2 (Service Code 5) provides details on the rationale and methods used to derive the carcinogenicity values found in IRIS. Users are referred to Section I for information on long-term toxic effects other than carcinogenicity.

__II.A. EVIDENCE FOR CLASSIFICATION AS TO HUMAN CARCINOGENICITY

___II.A.1. WEIGHT-OF-EVIDENCE CLASSIFICATION

Classification -- A; human carcinogen

Basis -- Several studies of increased incidence of nonlymphocytic leukemia from occupational exposure, increased incidence of neoplasia in rats and mice exposed by inhalation and gavage, and some supporting data form the basis for this classification.

___II.A.2. HUMAN CARCINOGENICITY DATA

Aksoy et al. (1974) reported effects of benzene exposure among 28,500 Turkish workers employed in the shoe industry. Mean duration of employment was 9.7 years (1-15 year range) and mean age was 34.2 years. Peak exposure was reported to be 210-650 ppm. Twenty-six cases of leukemia and a total of 34 leukemias or preleukemias were observed, corresponding to an incidence of 13/100,000 (by comparison to 6/100,000 for the general population). A follow-up paper (Aksoy, 1980) reported eight additional cases of leukemia as well as evidence suggestive of increases in other malignancies.

In a retrospective cohort mortality study Infante et al. (1977a,b) examined leukemogenic effects of benzene exposure in 748 white males exposed while employed in the manufacturing of rubber products. Exposure occurred from 1940-1949, and vital statistics were obtained through 1975. A statistically significant increase (p less than or equal to 0.002) of leukemias was found by comparison to the general U.S. population. There was no evidence of solvent exposure other than benzene. Air concentrations were generally found to be below the recommended limits in effect during the study period.

In a subsequent retrospective cohort mortality study Rinsky et al. (1981) observed seven deaths from leukemia among 748 workers exposed to benzene and followed for at least 24 years (17,020 person-years). This increased incidence was statistically significant; standard mortality ratio (SMR) was

560. For the five leukemia deaths that occurred among workers with more than 5 years exposure, the SMR was 2100. Exposures (which ranged from 10-100 ppm 8-hour TWA) were described as less than the recommended standards for the time period of 1941-1969.

In an updated version of the Rinsky et al. (1981) study, the authors followed the same cohort to 12/31/81 (Rinsky et al., 1987). An in his earlier study, cumulative exposure was derived from historic air-sampling data or interpolated estimates based on exisitng data. Standardized mortality rates ranged from 109 at cumulative benzene exposures under 40 ppm-years and increased montonically to 6637 (6 cases) at 400 ppm-years or more. The authors found significantly elevated risks of leukemia at cumulative exposures less than the equivalent current standard for occupational exposure which is 10 ppm over a 40-year working lifetime.

Ott et al. (1978) observed three deaths from leukemia among 594 workers followed for at least 23 years in a retrospective cohort mortality study, but the increase was not statistically significant. Exposures ranged from <2 to >25 ppm 8-hour TWA.

Wong et al. (1983) reported on the mortality of male chemical workers who had been exposed to benzene for at least 6 months during the years 1946-1975. The study population of 4062 persons was drawn from seven chemical plants, and jobs were categorized as to peak exposure. Those with at least 3 days/week exposure (3036 subjects) were further categorizeed on the basis of an 8-hour TWA. The control subjects held jobs at the same plants for at least 6 months but were never subject to benzene exposure. Dose-dependent increases were seen in leukemia and lymphatic and hematopoietic cancer. The incidence of leukemia was responsible for the majority of the increase. It was noted that the significance of the increase is due largely to a less than expected incidence of neoplasia in the unexposed subjects.

Numerous other epidemiologic and case studies have reported an increased incidence or a causal relationship between leukemia and exposure to benzene (IARC, 1982).

___II.A.3. ANIMAL CARCINOGENICITY DATA

Both gavage and inhalation exposure of rodents to benzene have resulted in development of neoplasia. Maltoni and Scarnato (1979) and Maltoni et al. (1983) administered benzene by gavage at dose levels of 0, 50, 250, and 500 mg/kg bw to 30-40 Sprague-Dawley rats/sex for life. Dose-related increased incidences of mammary tumors were seen in females and of Zymbal gland carcinomas, oral cavity carcinomas and leukemias/lymphomas in both sexes.

In an NTP (1986) study, benzene was administered by gavage doses of 0, 50, 100, or 200 mg/kg bw to 50 F344/N rats/sex or 0, 25, 50, or 100 mg/kg bw to 50 B6C3F1 mice/sex. Treatment was 5 times/week for 103 weeks. Significantly increased incidences ($p<0.05$) of various neoplasic growths were seen in both sexes of both species. Both male and female rats and mice had increased incidence of carcinomas of the Zymbal gland. Male and female rats had oral

cavity tumors, and males showed increased incidences of skin tumors. Mice of both sexes had increased incidence of lymphomas and lung tumors. Males were observed to have harderian and preputial gland tumors and females had tumors of mammary gland and ovary. In general, the increased incidence was dose-related.

Slightly increased incidences of hematopoietic neoplasms were reported for male C57Bl mice exposed by inhalation to 300 ppm benzene 6 hours/day, 5 days/week for 488 days. There was no increase in tumor incidence in male AKR or CD-1 mice similarly exposed to 100 ppm or 100 or 300 ppm benzene, respectively. Likewise male Sprague-Dawley rats exposed by inhalation to 300 ppm benzene were not observed to have increased incidence of neoplasia (Snyder et al., 1981).

Maltoni et al. (1983) treated male and female Sprague-Dawley rats in the following manner. Starting at 13 weeks of age rats were exposed to 200 ppm benzene 4 hours/day, 5 days/week for 7 weeks; 200 ppm 7 hours/day, 5 days/week for 12 weeks; 300 ppm 7 hours/day, 5 days/week for 85 weeks. An 8-hour/day TWA for 5 days/week was calculated to be 241 ppm. A statistically significant increase was noted in hepatomas and carcinomas of the Zymbal gland.

___II.A.4. SUPPORTING DATA FOR CARCINOGENICITY

Numerous investigators have found significant increases in chromosomal aberrations of bone marrow cells and peripheral lymphocytes from workers with exposure to benzene (IARC, 1982). Benzene also induced chromosomal aberrations in bone marrow cells from rabbits (Kissling and Speck, 1973), mice (Meyne and Legator, 1980) and rats (Anderson and Richardson, 1979). Several investigators have reported positive results for benzene in mouse micronucleus assays (Meyne and Legator, 1980). Benzene was not mutagenic in several bacterial and yeast systems, in the sex-linked recessive lethal mutation assay with Drosophila melanogaster or in mouse lymphoma cell forward mutation assay.

__II.B. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM ORAL EXPOSURE

___II.B.1. SUMMARY OF RISK ESTIMATES

Oral Slope Factor -- 2.9E-2 per (mg/kg)/day

Drinking Water Unit Risk -- 8.3E-7 per (ug/L)

Extrapolation Method -- One-hit (pooled data)

Drinking Water Concentrations at Specified Risk Levels:

Risk Level	Concentration

E-4 (1 in 10,000)	1E+2 ug/L
E-5 (1 in 100,000)	1E+1 ug/L
E-6 (1 in 1,000,000)	1E+0 ug/L

___II.B.2. DOSE-RESPONSE DATA (CARCINOGENICITY, ORAL EXPOSURE)

Tumor Type -- leukemia
Test Animals -- human
Route -- inhalation, occupational exposure
Reference -- Rinsky et al., 1981; Ott et al., 1978; Wong et al., 1983

The slope factor was derived from human data for inhalation exposure (see dose-response data for inhalation quantitative estimate). The human respiratory rate was assumed to be 20 cu.m/day and the human drinking water intake was assumed to be 2 L/day. The fraction of the administered dose absorbed systemically via inhalation and via drinking water were assumed to be equal.

___II.B.3. ADDITIONAL COMMENTS (CARCINOGENICITY, ORAL EXPOSURE)

The unit risk estimate is the geometric mean of four ML point estimates using pooled data from the Rinsky et al. (1981) and Ott et al. (1978) studies, which was then adjusted for the results of the Wong et al. (1983) study as described in the additional comments section for inhalation data.

The unit risk should not be used if the water concentration exceeds 1E+4 ug/L, since above this concentration the unit risk may not be appropriate.

___II.B.4. DISCUSSION OF CONFIDENCE (CARCINOGENICITY, ORAL EXPOSURE)

The pooled cohorts were sufficiently large and were followed for an adequate time period. The increases in leukemias were statistically significant and dose-related in one of the studies. Wong et al. (1983) disagrees that exposures reported in Rinsky et al. (1981) were within the recommended standards. For the five leukemia deaths in persons with 5 or more years exposure, the author notes that mean exposure levels (range 15-70 ppm) exceeded the recommended standard (25 ppm) in 75% of the work locations sampled. A total of 21 unit risk estimates were prepared using 6 models and various combinations of the epidemiologic data. These range over slightly more than one order of magnitude. A geometric mean of these estimates is 2.7E-2. Regression models give an estimate similar to the geometric mean.

The risk estimate above based on reconsideration of the Rinsky et al. (1981) and Ott et al. (1978) studies is very similar to that of 2.4E-2/ppm (cited in U.S. EPA, 1980) based on Infante et al. (1977a,b), Ott et al. (1978) and Aksoy et al. (1974). It was felt by the authors of U.S. EPA (1985) that

the exposure assessment provided by Aksoy was too imprecise to warrant inclusion in the current risk estimate.

Risk estimates based on animal gavage studies are about 5 times higher than those derived from human data. Pharmacokinetic data which could impact the risk assessment are currently being evaluated.

II.C. QUANTITATIVE ESTIMATE OF CARCINOGENIC RISK FROM INHALATION EXPOSURE

II.C.1. SUMMARY OF RISK ESTIMATES

Inhalation Unit Risk -- 8.3E-6 per (ug/cu.m)

Extrapolation Method -- One-hit (pooled data)

Air Concentrations at Specified Risk Levels:

Risk Level	Concentration
E-4 (1 in 10,000)	1E+1 ug/cu.m
E-5 (1 in 100,000)	1E+0 ug/cu.m
E-6 (1 in 1,000,000)	1E-1 ug/cu.m

II.C.2. DOSE-RESPONSE DATA FOR CARCINOGENICITY, INHALATION EXPOSURE

Tumor Type -- leukemia
Test Animals -- humans
Route -- inhalation, occupational exposure
Reference -- Rinsky et al., 1981; Ott et al., 1978; Wong et al., 1983

II.C.3. ADDITIONAL COMMENTS (CARCINOGENICITY, INHALATION EXPOSURE)

The unit risk estimate is the geometric mean of four ML point estimates using pooled data from the Rinsky et al. (1981) and Ott et al. (1978) studies, which was then adjusted for the results of the Wong et al. (1983) study. The Rinsky data used were from an updated tape which reports one more case of leukemia than was published in 1981. Equal weight was given to cumulative dose and weighted cumulative dose exposure categories as well as to relative and absolute risk model forms. The results of the Wong et al. (1983) study were incorporated by assuming that the ratio of the Rinsky-Ott-Wong studies to the Rinsky-Ott studies for the relative risk cumulative dose model was the same as for other model-exposure category combinations and multiplying this ratio by the Rinsky-Ott geometric mean. The age-specific U.S. death rates for 1978 (the most current year available) were used for background leukemia and

total death rates. It should be noted that a recently published paper (Rinsky et al., 1987) reported yet another case of leukemia from the study population.

The unit risk should not be used if the air concentration exceeds 100 ug/cu.m, since above this concentration the unit risk may not be appropriate.

___II.C.4. DISCUSSION OF CONFIDENCE (CARCINOGENICITY, INHALATION EXPOSURE)

The pooled cohorts were sufficiently large and were followed for an ade quate time period. The increases in leukemias were statistically significant and dose-related in one of the studies. Wong et al. (1983) disagrees that exposures reported in Rinsky et al. (1981) were within the recommended standards. For the five leukemia deaths in persons with 5 or more years exposure, the author notes that mean exposure levels (range 15-70 ppm) exceeded the recommended standard (25 ppm) in 75% of the work locations sampled. The risk estimate above based on reconsideration of the Rinsky et al. (1981) and Ott et al. (1978) studies is very similar to that of 2.4E-2/ppm (cited in U.S. EPA, 1980) based on Infante et al. (1977a,b), Ott et al. (1978) and Aksoy et al. (1974). It was felt by the authors of U.S. EPA (1985) that the exposure assessment provided by Aksoy was too imprecise to warrant inclusion in the current risk estimate. A total of 21 unit risk estimates were prepared using 6 models and various combinations of the epidemiologic data. These range over slightly more than one order of magnitude. A geometric mean of these estimates is 2.7E-2/ppm. Regression models give an estimate similar to the geometric mean.

__II.D. EPA DOCUMENTATION, REVIEW, AND CONTACTS (CARCINOGENICITY ASSESSMENT)

___II.D.1. EPA DOCUMENTATION

U.S. EPA. 1980. Ambient Water Quality Criteria Document for Benzene. Prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office (Cincinnati, OH) and Carcinogen Assessment Group (Washington, DC), and the Environmental Research Labs (Corvalis, OR; Duluth, MN; Gulf Breeze, FL) for the Office of Water Regulations and Standards, Washington, DC. EPA 440/5-80-018.

U.S. EPA. 1985. Interim Quantitative Cancer Unit Risk Estimates Due to Inhalation of Benzene. Prepared by the Office of Health and Environmental Assessment, Carcinogen Assessment Group, Washington, DC for the Office of Air Quality Planning and Standards, Washington, DC.

U.S. EPA. 1987. Memorandum from J. Orme, HEB, CSD/ODW to C. Vogt, Criteria and Standards Division, ODW, June, 1987.

___II.D.2. REVIEW (CARCINOGENICITY ASSESSMENT)

The 1985 Interim Evaluation was reviewed by the Carcinogen Assessment Group.

The 1987 memorandum is an internal document.

Agency Work Group Review: 03/05/87, 10/09/87

Verification Date: 10/09/87

___II.D.3. U.S. EPA CONTACTS (CARCINOGENICITY ASSESSMENT)

D.L. Bayliss / ORD -- (202)260-5726 / FTS 260-5726

R. McGaughy / ORD -- (202)260-5898 / FTS 260-5898

---------- PROTECTION AND FIRST AID ----------

PROTECTION SUGGESTED
FROM THE CHRIS MANUAL:
hydrocarbon vapor canister, supplied air or hose mask; hydrocarbon-insoluble rubber or plastic gloves; chemical goggles or face splash shield; hydrocarbon-insoluble apron such as neoprene.

NIOSH POCKET GUIDE TO CHEMICAL HAZARDS:

** WEAR APPROPRIATE EQUIPMENT TO PREVENT:
Repeated or prolonged skin contact.

** WEAR EYE PROTECTION TO PREVENT:
Reasonable probability of eye contact.

** EXPOSED PERSONNEL SHOULD WASH:
Promptly wash with soap when skin becomes contaminated.

** REMOVE CLOTHING:
Immediately remove any clothing that becomes wet to avoid any flammability

** REFERENCE: NIOSH

RECOMMENDED RESPIRATION PROTECTION Source: NIOSH POCKET GUIDE (85-114)
OSHA (BENZENE)
Less than or equal to 10 ppm: Half-mask air-purifying respirator with organic vapor cartridge.
Less than or equal to 50 ppm: Full facepiece respirator with organic vapor cartridges. / Full facepiece gas mask with chin style canister.

Less than or equal to 100 ppm: Full facepiece powered air-purifying respirator with organic vapor canister.
Less than or equal to 1000 ppm: Supplied air respirator with full facepiece in positive-pressure mode.
Greater than 1000 ppm or Unknown concentration: (1) Self-contained breathing apparatus with full face-piece in positive pressure mode. (2) Full facepiece positive-pressure supplied-air respirator with auxiliary self-contained air supply.
Escape : (1) Any organic vapor gas mask; or (2) Any self-contained breathing apparatus with full facepiece.
Firefighting : Any full facepiece self-contained breathing apparatus operated in positive pressure mode.

'RTP51' LINE 1. [B28] Not enough string space - Out of Memory.

ATTACHMENT B

HEALTH AND SAFETY PLAN FORMS

PLAN ACCEPTANCE FORM

PROJECT HEALTH AND SAFETY PLAN

INSTRUCTIONS: This form is to be completed by each person working on the project site and returned to: EnSafe/Allen & Hoshall, Memphis, Tennessee.

Job No: 0106-071222

Contract No: N62467-89-D-0318

Project: SWMU 22 — S-75 Underground Storage Tanks
SWMU 63 — S-75 Underground Waste Tank

I have read and understand the contents of the above plan and agree to perform my work in accordance with it.

_____

Signed

_____

Print Name

_____

Company

_____

Date

EMPLOYEE EXPOSURE HISTORY FORM

Employee:

Job Name: _____

Date(s) From/To: _____

Hours Onsite: _____

Contaminants (Suspected/Reported):

_____

_____

_____

_____

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_____

(See Attached Laboratory Analysis)

PLAN FEEDBACK FORM

Problems with plan requirements:

Unexpected situations encountered:

Recommendations for revisions:

ACCIDENT REPORT FORM

SUPERVISOR'S REPORT OF ACCIDENT	DO NOT USE FOR MOTOR VEHICLE OR AIRCRAFT ACCIDENTS
TO	FROM TELEPHONE (Include area code)
NAME OF INJURED OR ILL WORKER AND COMPANY	
WORKER'S SOCIAL SECURITY NUMBER	

DATE OF ACCIDENT	TIME OF ACCIDENT	EXACT LOCATION OF ACCIDENT

NARRATIVE DESCRIPTION OF ACCIDENT

NATURE OF ILLNESS OR INJURY AND PART OF BODY INVOLVED	LOST TIME YES ☐ NO ☐

PROBABLE DISABILITY (Check one)

FATAL ☐ LOST WORKDAY WITH ____DAYS AWAY FROM WORK ☐ LOST WORKDAY WITH ____DAYS OF RESTRICTED ACTIVITY ☐ NO LOST WORKDAY ☐ FIRST-AID ONLY ☐

CORRECTIVE ACTION RECOMMENDED (By whom and by when)

NAME OF SUPERVISOR	TITLE
SIGNATURE	DATE

ATTACHMENT C

DIRECTIONS TO EMERGENCY MEDICAL FACILITIES

DIRECTIONS TO THE NEAREST MEDICAL FACILITIES

Methodist Hospital North is the nearest hospital **and** the nearest facility capable of treating chemical burns. Therefore, there is only one set of directions.

Nearest Hospital

Methodist North Hospital
3960 Covington Pike
Memphis, Tennessee

Emergency Room Telephone Number - (901) 372-5211

Directions to Methodist North Hospital from NSA Memphis Main Gate:

1) Exit site through South Gate (Singleton Parkway).

2) Continue on Singleton Parkway through the stop signs.

3) Singleton Parkway and Covington Pike will intersect at a red light (about 5 miles).

4) You will see the entrance to the emergency room 700 feet past this light on the left.

INSERT MAP TO HOSPITAL